

# DIABETIC RETINOPATHY 2019

## WHAT EVERY PROVIDER NEEDS TO KNOW ABOUT DIABETIC RETINAL EXAM

Mohan Iyer, MD  
Athens Retina Center



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# Financial Disclosure: None

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# Learning Objectives

Basic anatomy of the eye

Recognize the importance of diabetic retinopathy as a public health problem

Identify the risk factors for diabetic retinopathy

Describe the stages of diabetic retinopathy

Understand the role of risk factor control and annual dilated eye exams in the prevention of vision loss

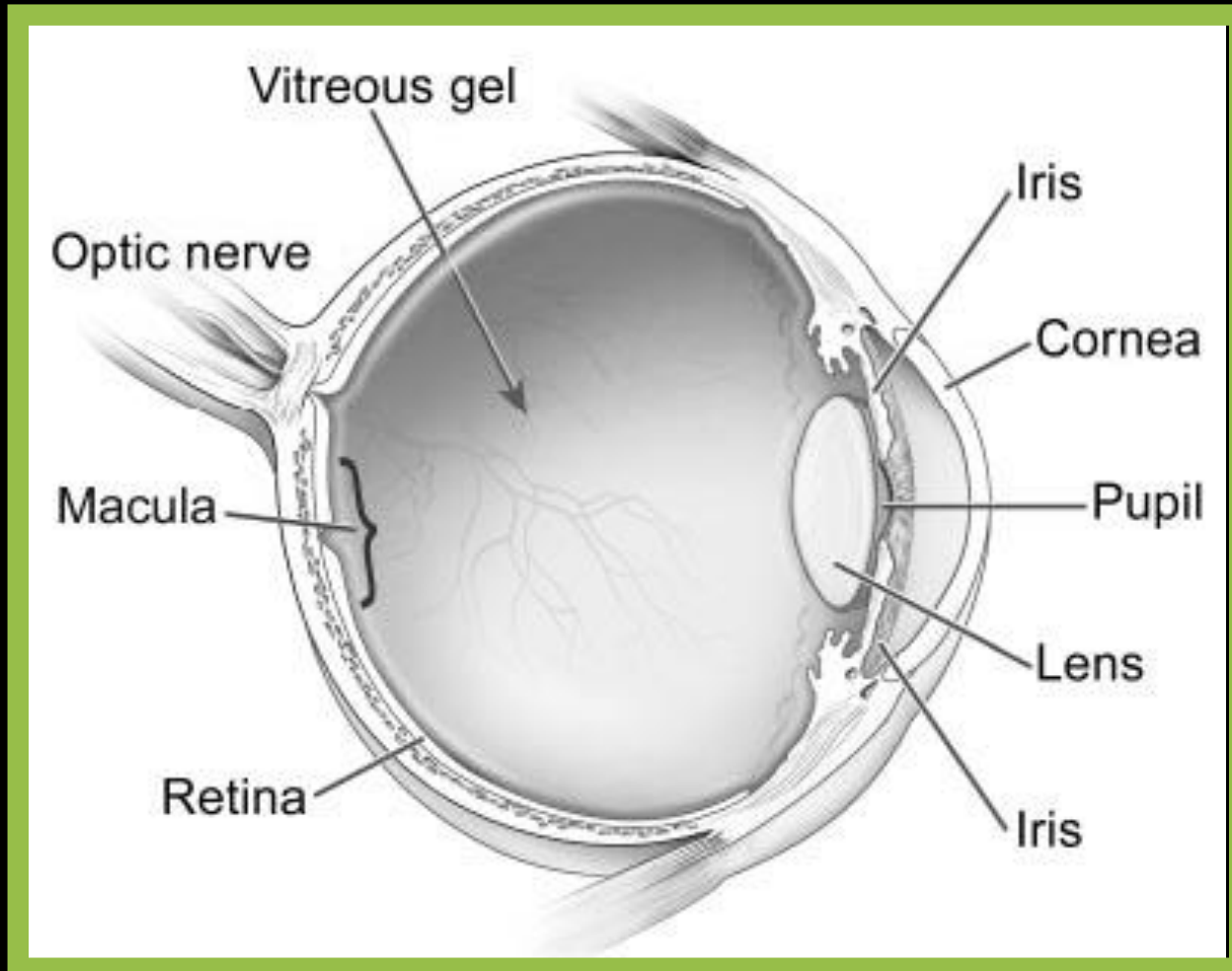
- What is the most common cause of vision loss among working age adults in the United States?
- 1. Glaucoma
- 2. Cataract
- 3. Diabetic Retinopathy
- 4. Retinal Detachment

- The most common cause of moderate vision loss in diabetic retinopathy is:
  - 1. Refractive Change
  - 2. Cataract
  - 3. Diabetic Macular Edema
  - 4. Proliferative Diabetic Retinopathy

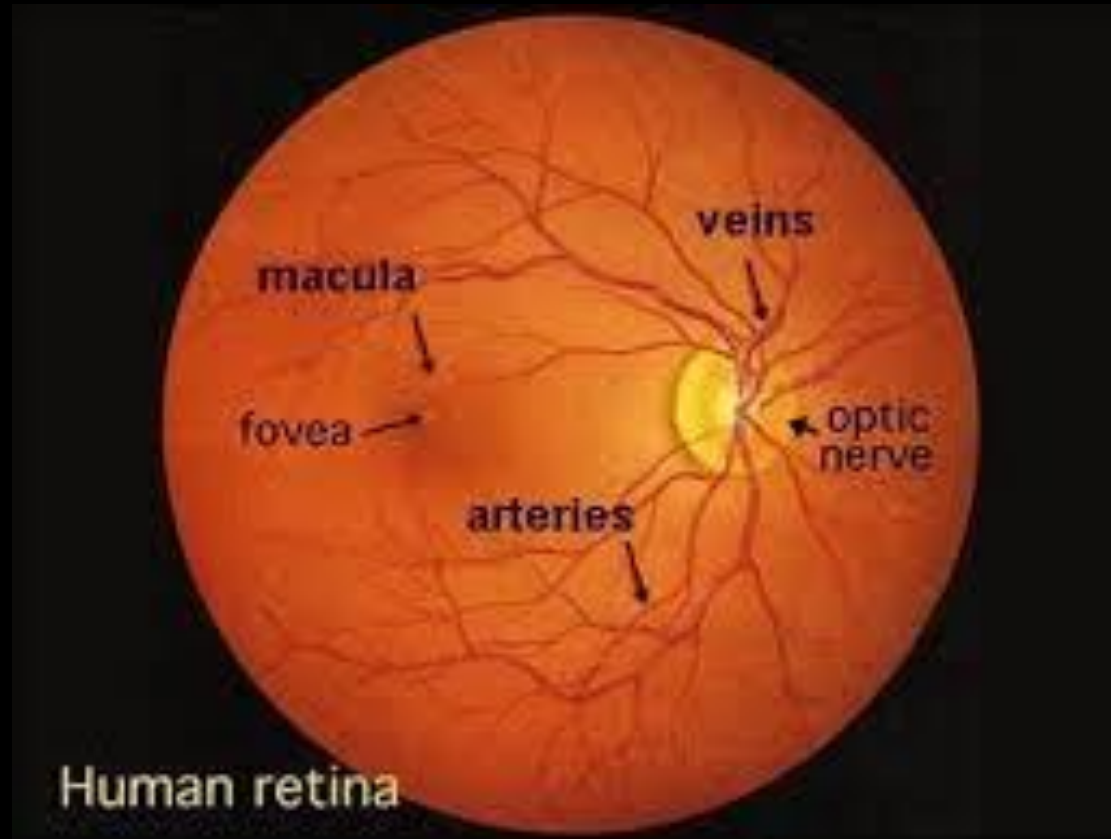
**A patient with Type II diabetes should get their first dilated eye exam:**

- 1. Only when the vision is affected**
- 2. In 3-5 years after initial diagnosis of diabetes**
- 3. At the time of diagnosis of diabetes**
- 4. 1 year after the diagnosis of diabetes**

# Anatomy of the Eye

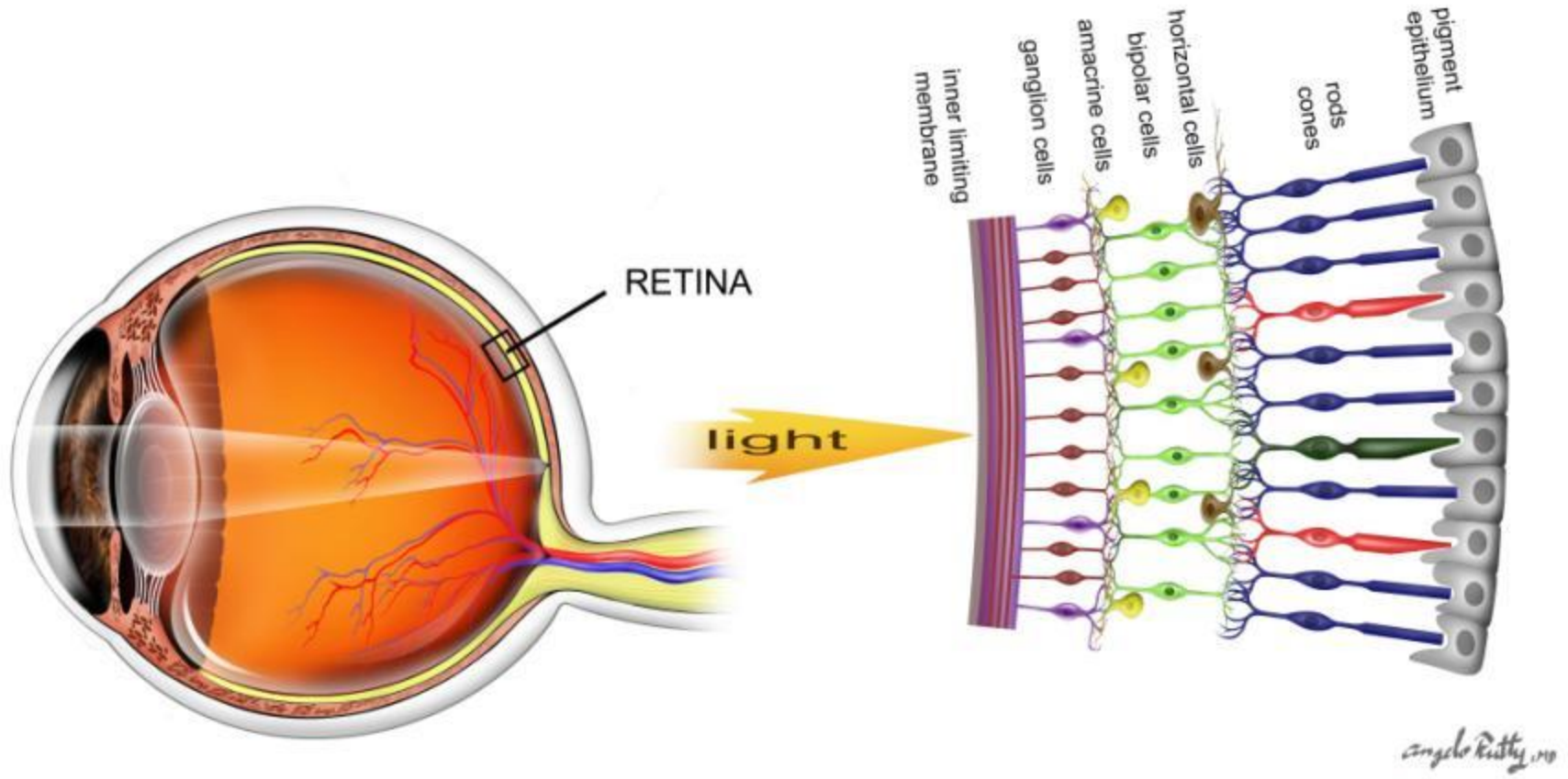


# Anatomy of the Eye





# RETINA



Healthy Retina



Diabetic Retinopathy



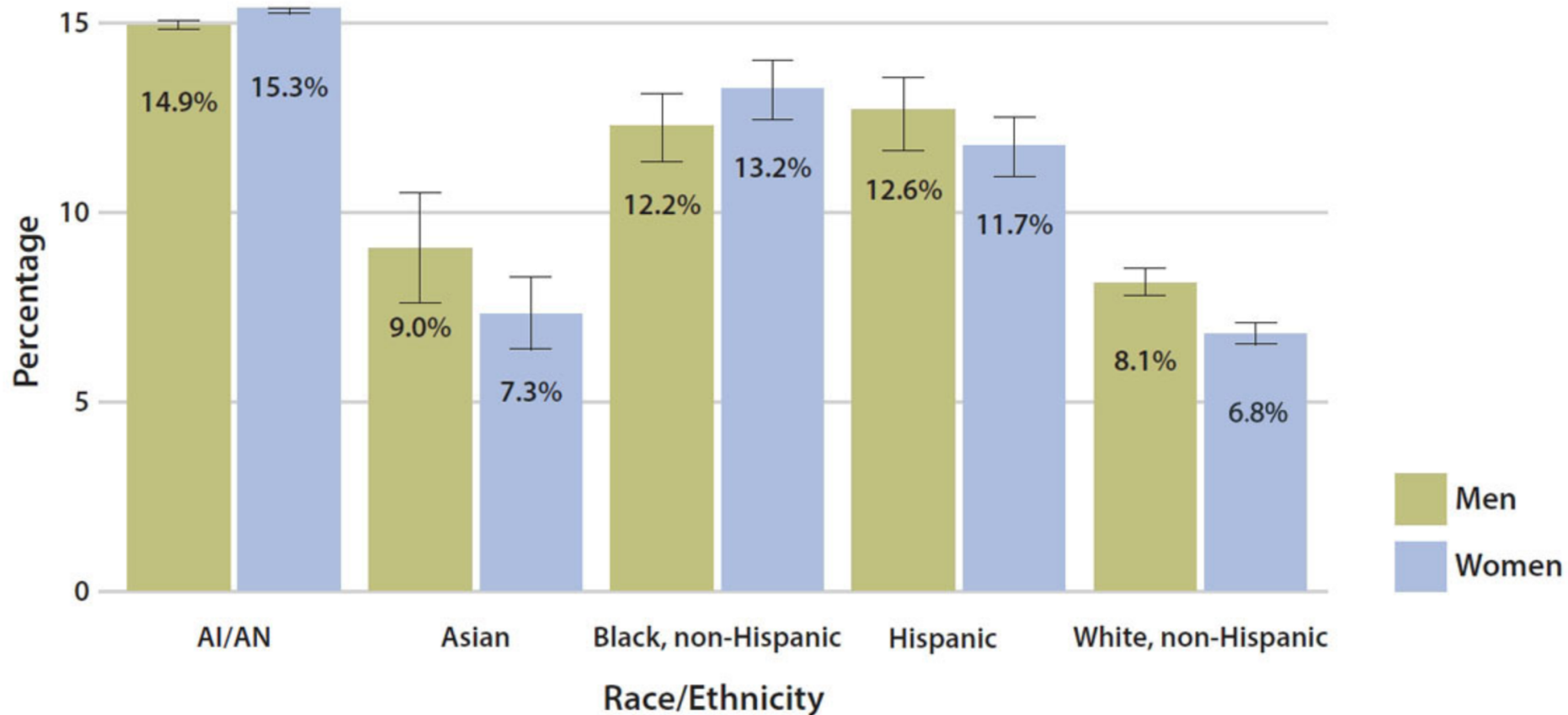
# Diabetes Epidemiology

## Diabetes in the United States

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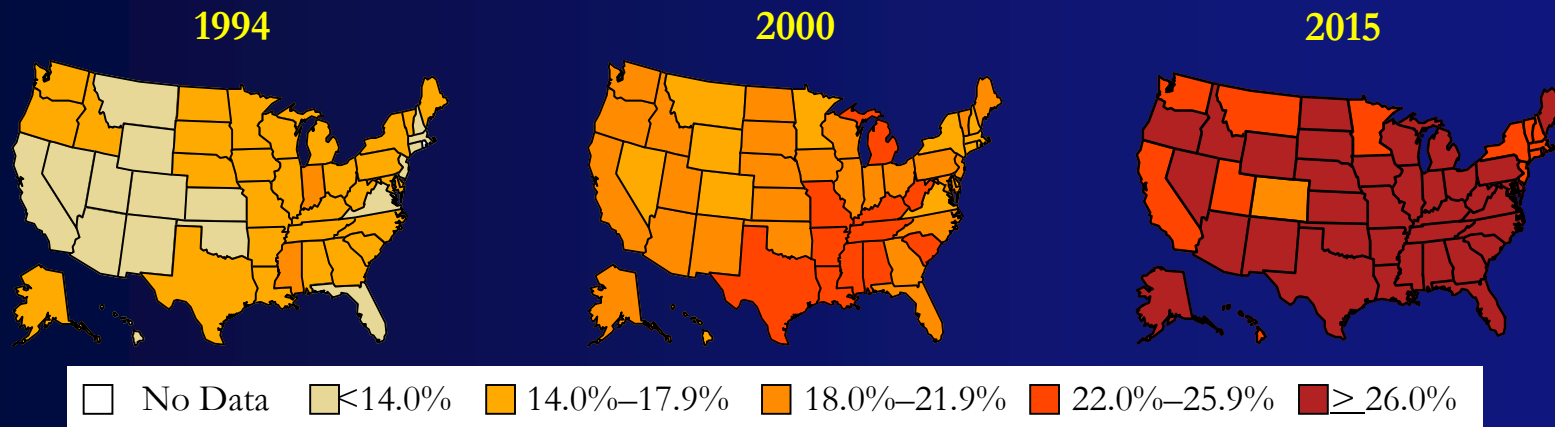
- ▶ National Diabetes Statistics Report (2014) found that in 2012:
  - » 29.1 million Americans (9.3% of the population) have diabetes
  - » 8.1 million undiagnosed
  - » 86 million Americans (27%) age 20 and older have prediabetes, up 7 million from 2010
- ▶ Total diagnosed + undiagnosed cases of diabetes in the U.S. projected to nearly triple by 2050
- ▶ Cost to the U.S. government - **\$500 million** annually

Estimated age-adjusted prevalence of diagnosed diabetes by race/ethnicity  
and sex among adults aged  $\geq 18$  years, United States, 2013–2015

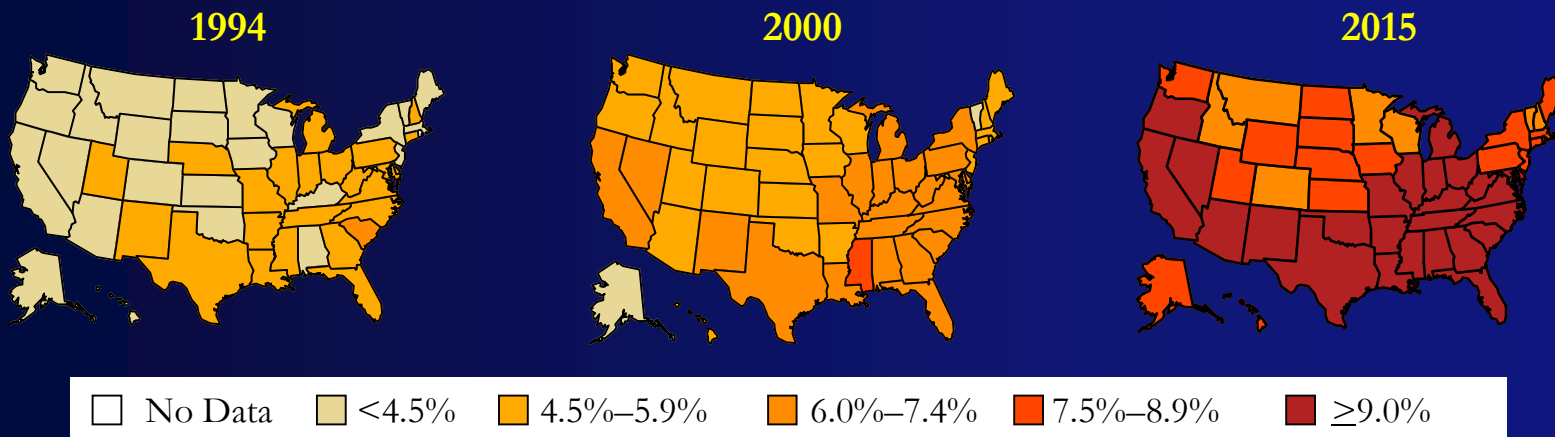


# Age-adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults

## Obesity (BMI $\geq 30$ kg/m<sup>2</sup>)



## Diabetes



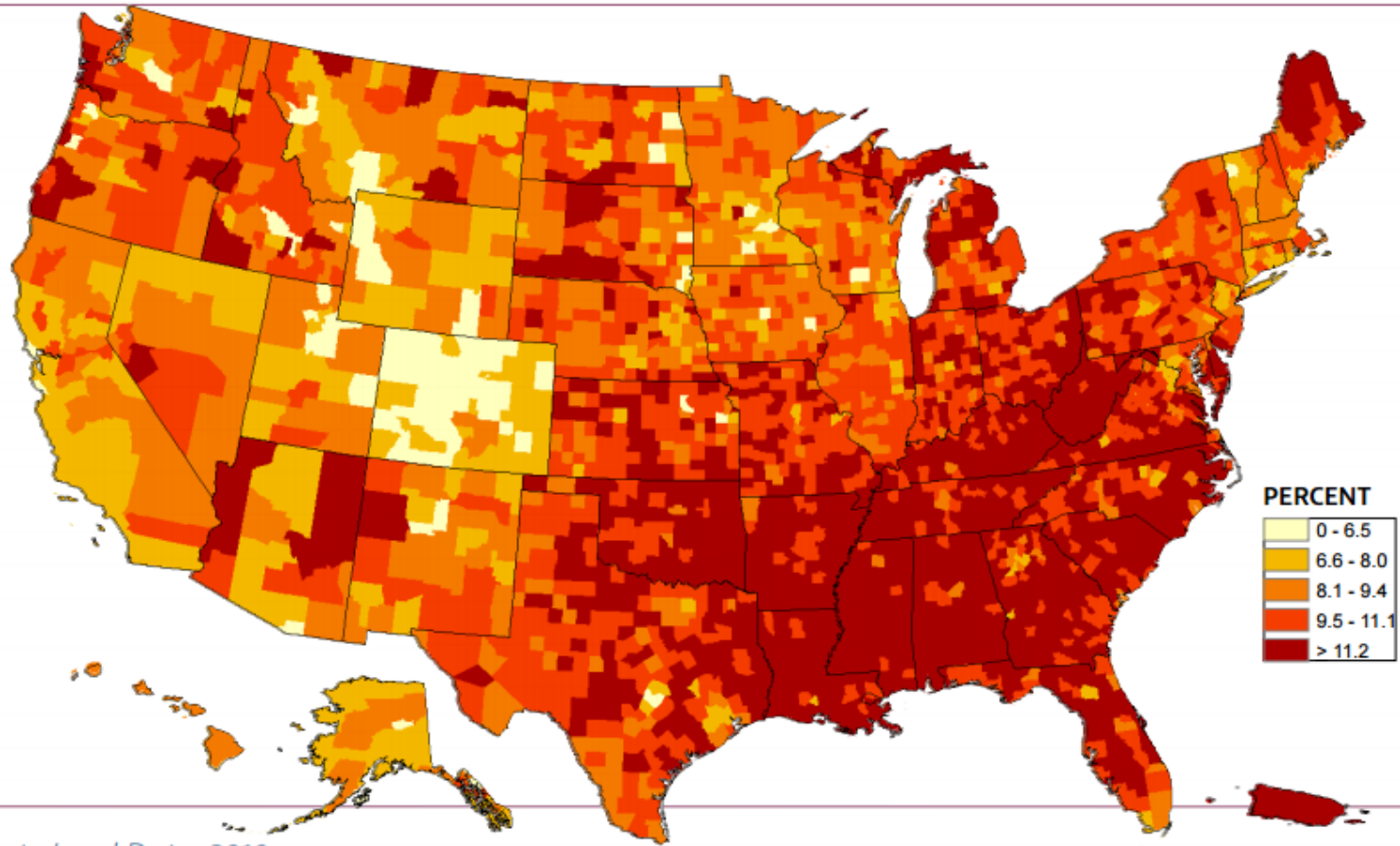
CDC's Division of Diabetes Translation. United States Surveillance System available at <http://www.cdc.gov/diabetes/data>



**"I think diabetes is affecting my eyesight.  
I have trouble seeing the consequences  
of my food choices."**



# Diabetes Prevalence Among Adults, Age 20+: United States 2004-2010



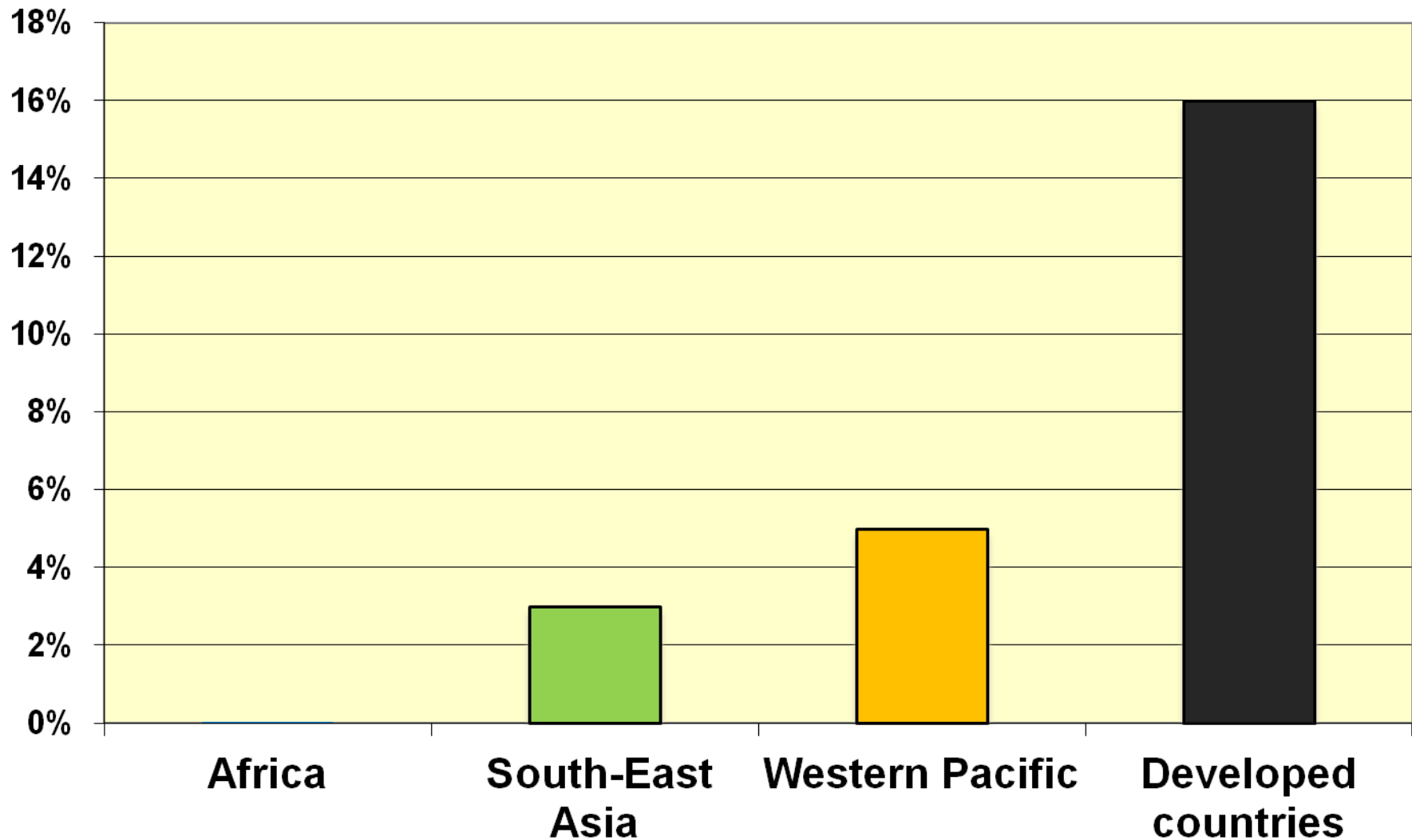
CDC, County Level Data, 2010

# Diabetic Retinopathy Epidemiology

- **CDC study** (<https://www.cdc.gov/visionhealth/pdf/factsheet.pdf>)
- **One in 3 people over the age of 40 years with diabetes have diabetic retinopathy**
- **4.2 million adults had Diabetic retinopathy**
- **655,000 had vision-threatening diabetic retinopathy**
- **The more severe vision-threatening form is more common in Mexican Americans and African-Americans.**
- **Diabetic retinopathy (DR) is the leading cause of blindness in people of working age in industrialized countries.**



# Global Prevalence Diabetic Retinopathy



# Risk factors for DR

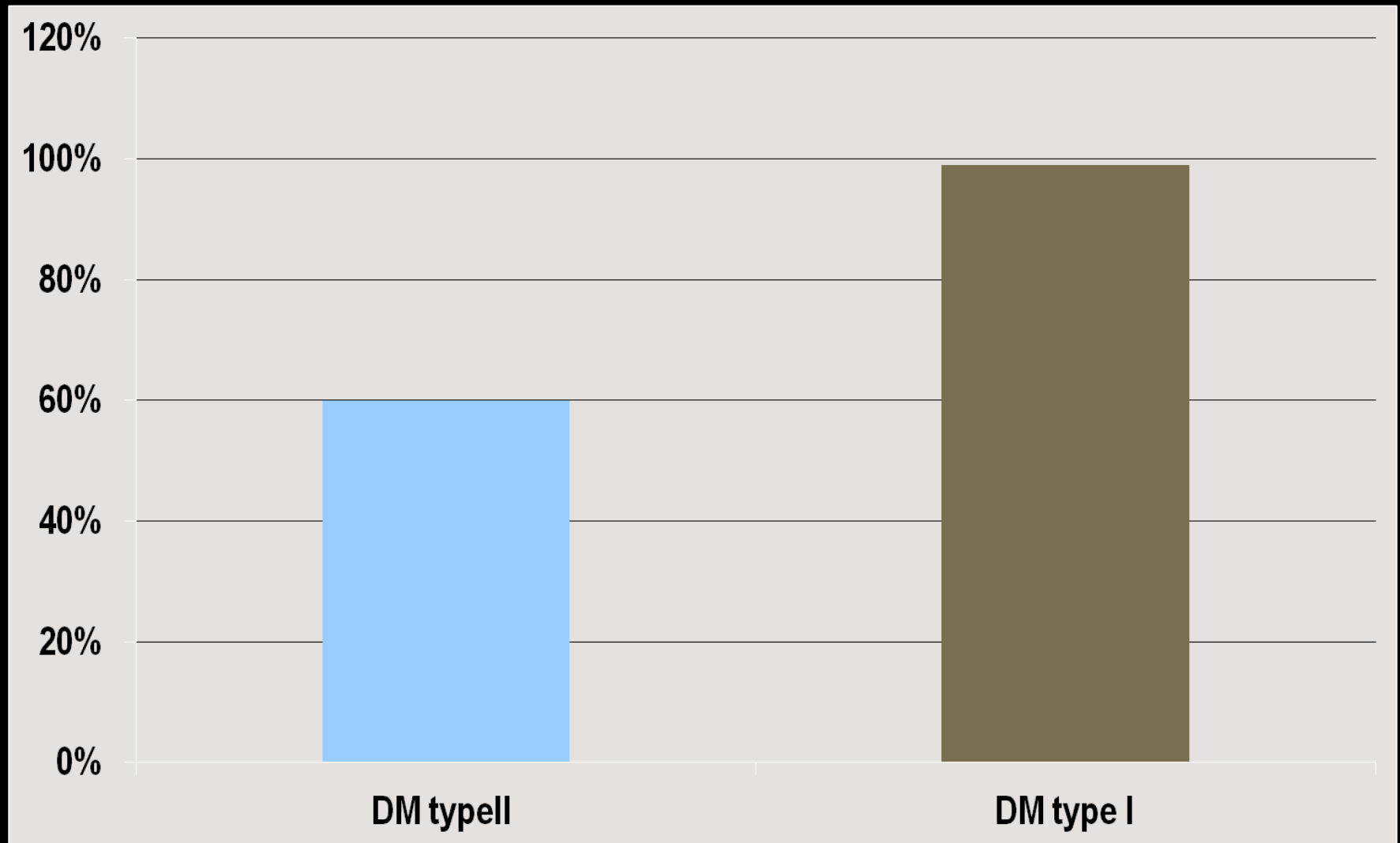
- **Male sex**
- **Higher A1C**
- **Longer duration of diabetes**
- **Insulin use**
- **Higher systolic blood pressure**
- **Barriers to care**

# Diabetic Retinopathy

## Epidemiology

- The best predictor of diabetic retinopathy is the duration of the disease
- After 20 years of diabetes, nearly 99% of patients with type 1 diabetes and 60% with type 2 have some degree of diabetic retinopathy
- 33% of patients with diabetes have signs of diabetic retinopathy
- People with diabetes are 25 times more likely to become blind than the general population.

# Prevalence of diabetic retinopathy after 20 years of diagnosis



# Diabetic Retinopathy

## Pathophysiology

- Elevated blood glucose results in physiologic changes that cause vascular endothelial damage.
  - Loss of pericytes
  - Basement membrane thickening
- Pathologic processes associated with diabetic retinopathy
  - Formation of microaneurysms
  - Closure of retinal capillaries and arterioles
  - Increased vascular permeability of retinal capillaries
  - Proliferation of new vessels and fibrous tissue
  - Contraction of vitreous and fibrous proliferation leading to tractional retinal detachment

# Diabetic Retinopathy

- Risk Factors associated with progression of diabetic retinopathy :
  - Hypertension
  - Elevated triglycerides
  - Elevated lipids,
  - Gross proteinuria
- Patients with Proliferative Diabetic Retinopathy are at increased risk of myocardial infarction, stroke, diabetic nephropathy, amputation, and death
- NOTE: No ocular contraindications to aspirin when required for cardiovascular disease or other medical conditions.

# Diabetic Retinopathy

## Causes of vision loss

- Macular edema (thickening of central retina)
- Macular ischemia
- Macular/foveal hemorrhage
- Vitreous or preretinal hemorrhage
- Retinal traction and detachment

# Diabetic retinopathy symptoms

Diabetic retinopathy is asymptomatic in early stages of the disease

As the disease progresses symptoms may include

- Blurred vision
- Floaters
- Fluctuating vision
- Distorted vision
- Dark areas in the vision
- Poor night vision
- Impaired color vision
- Partial or total loss of vision



# 4 Stages of Diabetic Retinopathy:

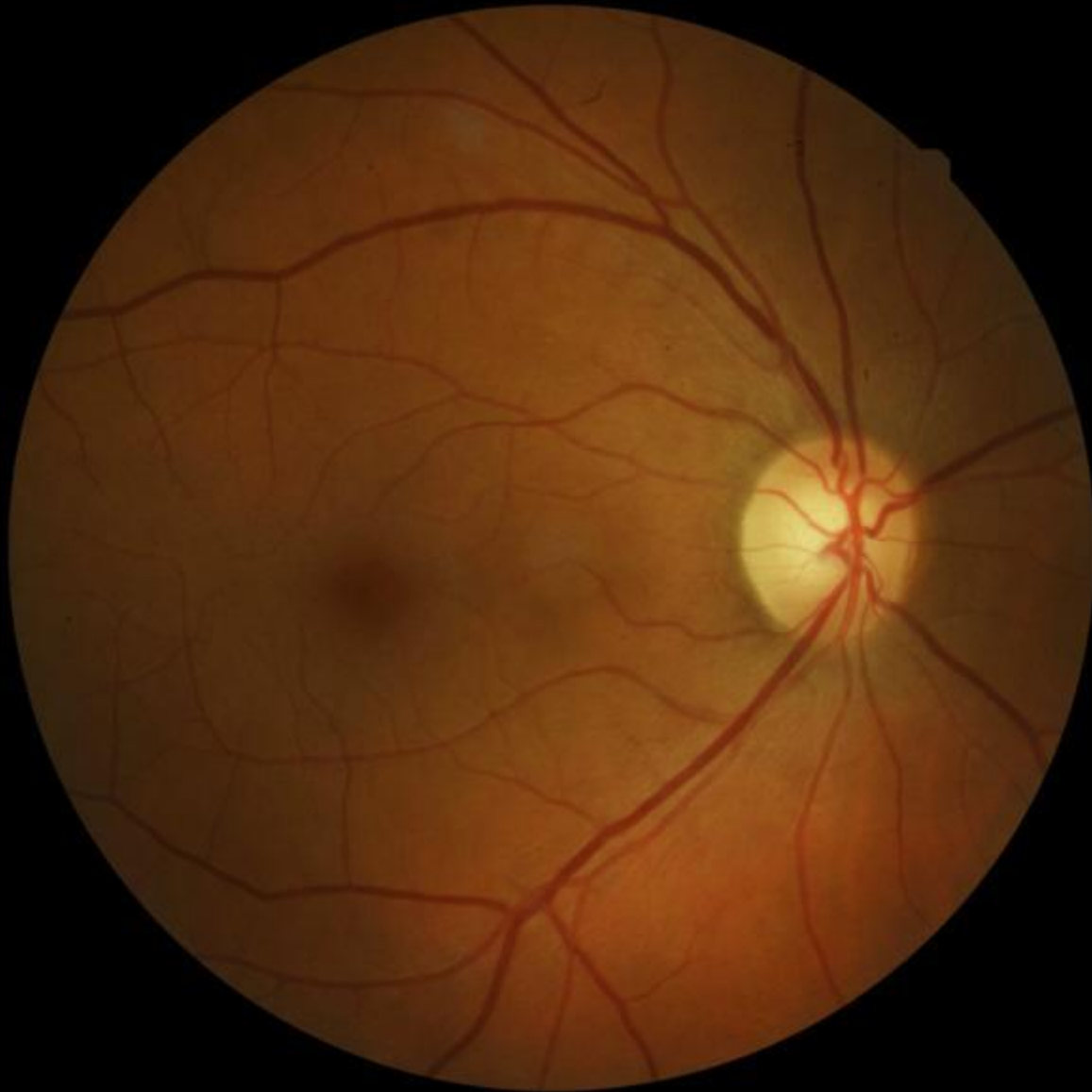
- 
1. Mild Nonproliferative Retinopathy (NPDR)
  2. Moderate Nonproliferative Retinopathy
  3. Severe Nonproliferative Retinopathy
  4. Proliferative Retinopathy (PDR)

**Goal is to diagnose as early as possible!**

# Risk of Progression from NPDR to PDR

	1 year	5yrs
Mild NPDR	5%	15%
Moderate NPDR	27%	33%
Severe NPDR	52%	60%
Very Severe NPDR	75%	

No retinopathy

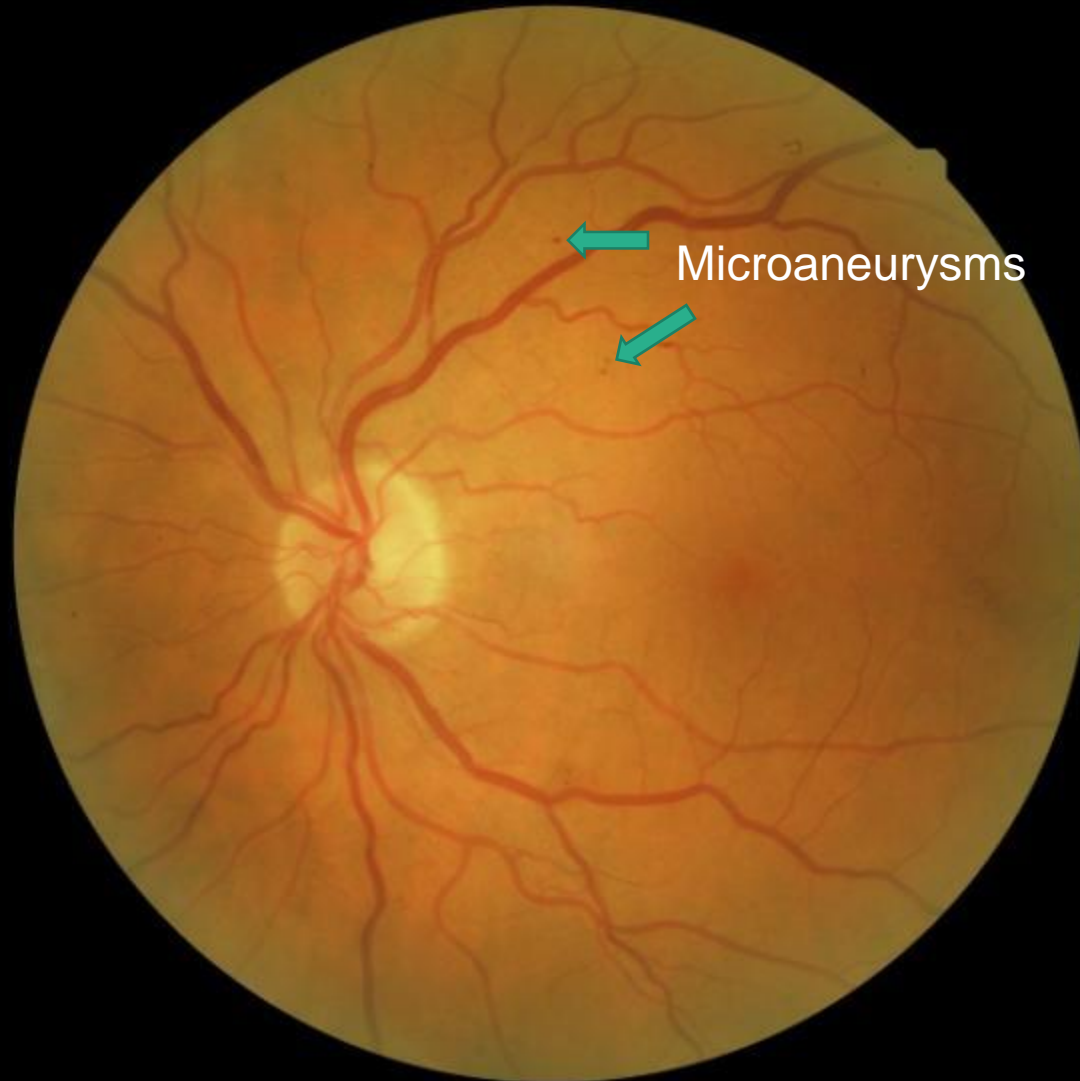


# MILD NONPROLIFERATIVE DIABETIC RETINOPATHY

## Characteristics

- Microaneurysms only

# MILD NONPROLIFERATIVE DIABETIC RETINOPATHY

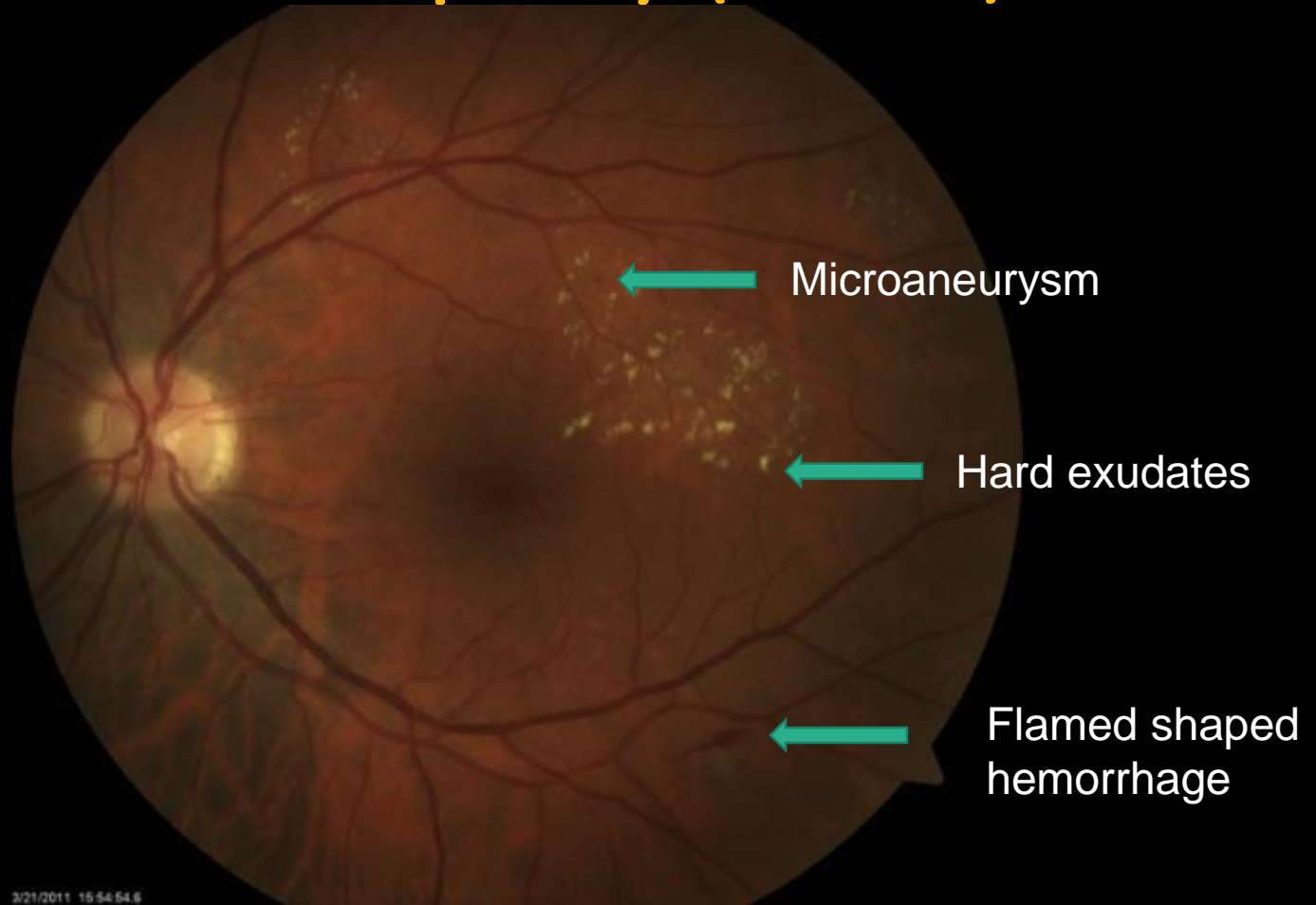


# Moderate Nonproliferative Diabetic Retinopathy (NPDR)

## Characteristics

More than just microaneurysms but less than severe NPDR

# Moderate Nonproliferative Diabetic Retinopathy (NPDR)



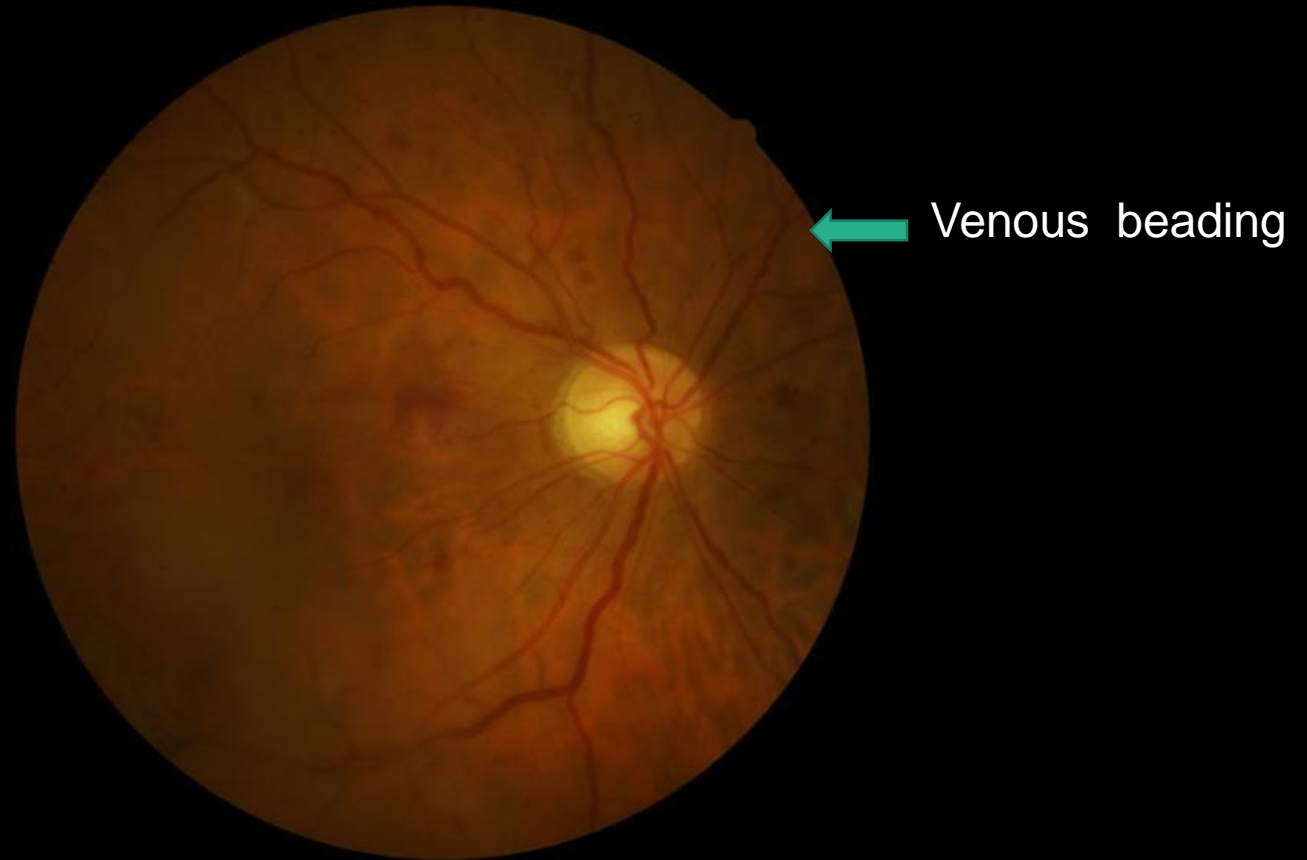
# Severe Nonproliferative Diabetic Retinopathy (NPDR)

Any of the following:

- More than 20 intraretinal hemorrhages in each of four quadrants
- Venous beading in two or more quadrants
- Prominent Intraretinal Microvascular Abnormalities (IRMA) in one or more quadrants
- **And** no signs of proliferative retinopathy



# Severe Nonproliferative Diabetic Retinopathy (NPDR)



# PROLIFERATIVE DIABETIC RETINOPATHY

Neovascularization



# Diabetic macular edema

- Diabetic macular edema is the leading cause of legal blindness in diabetics.
- Diabetic macular edema can be present at any stage of the disease, but is more common in patients with proliferative diabetic retinopathy.

**Normal**

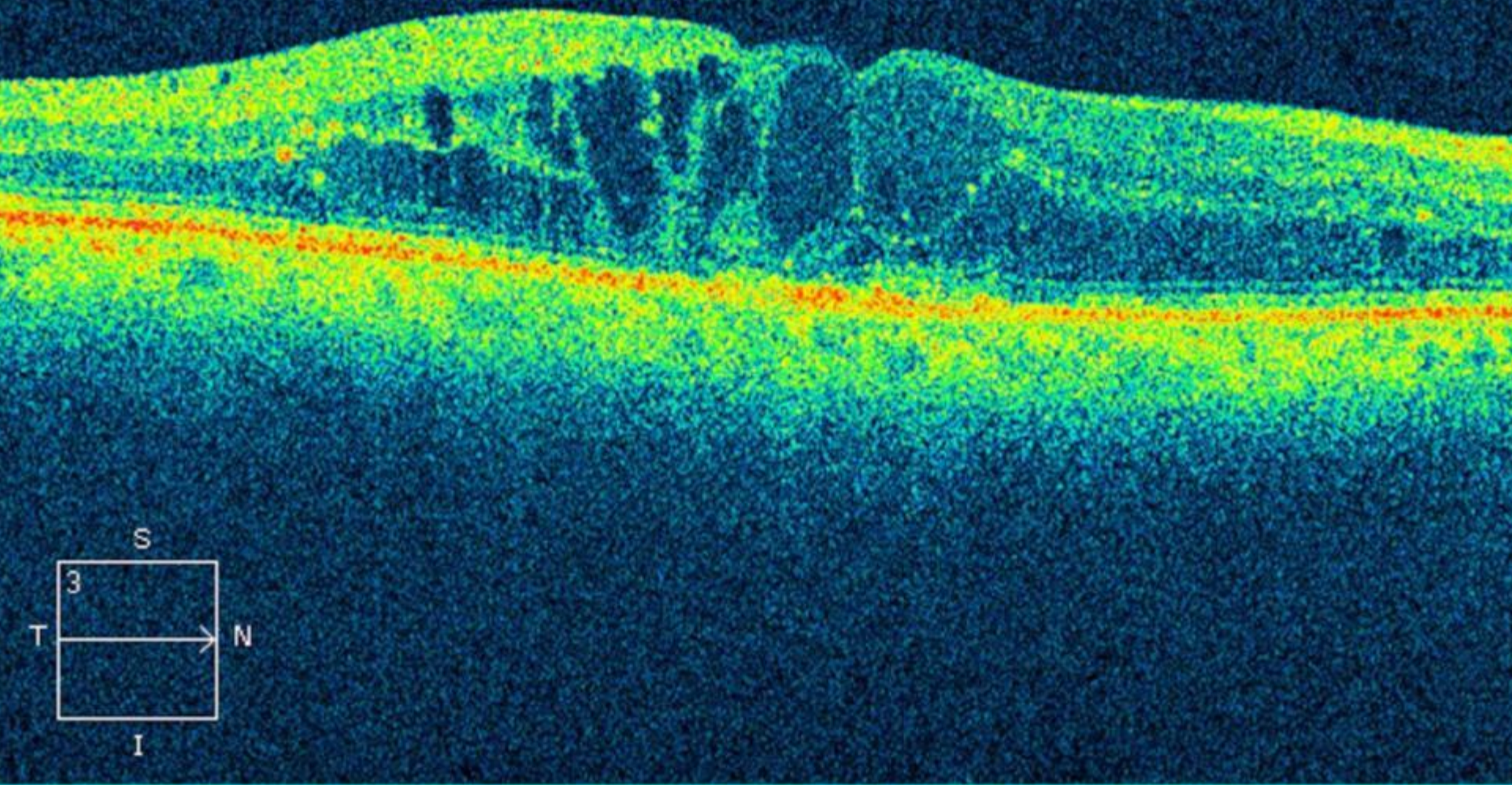


**Macular Edema**

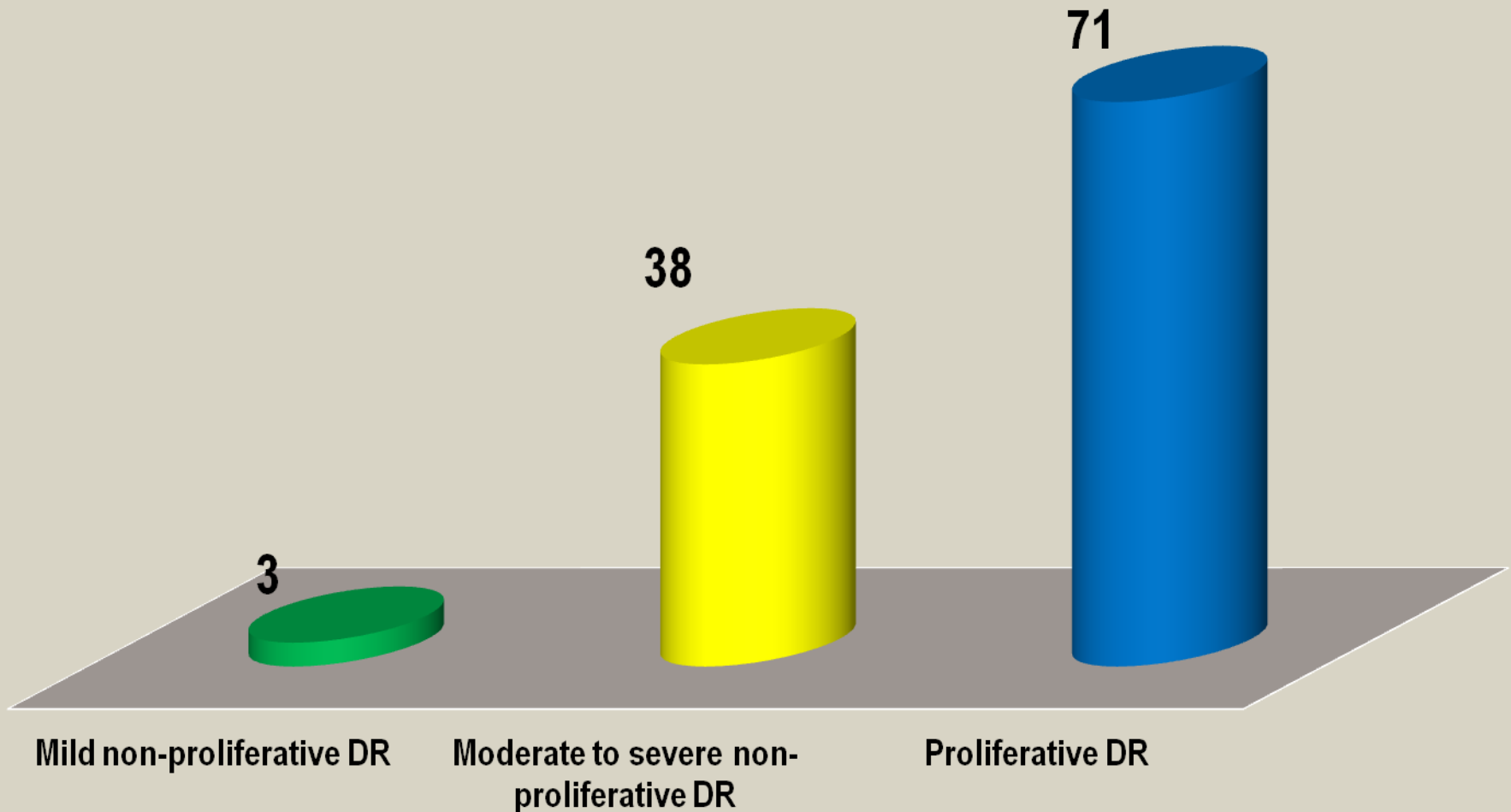




# Imaging of macular edema with optical coherence tomography

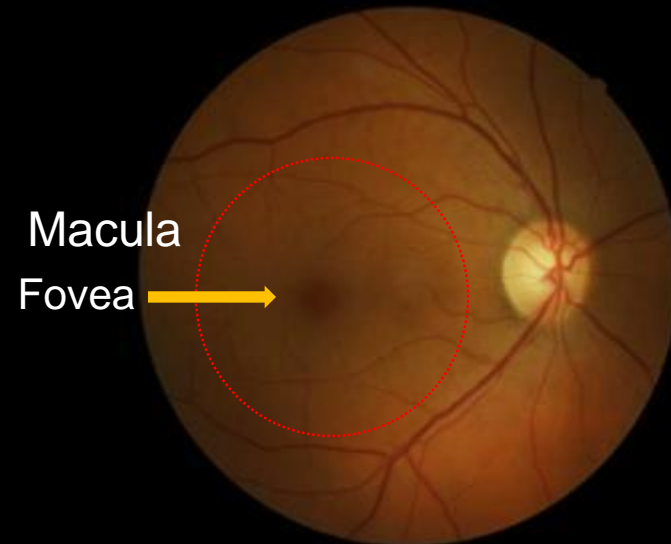


# Diabetic Macular Edema Prevalence



# Why is Diabetic macular edema so important?

- The macula is responsible for central vision.
- Diabetic macular edema may be asymptomatic at first. As the edema moves in to the fovea (the center of the macula) the patient will notice blurry central vision. The ability to read and recognize faces will be compromised.







**Normal Vision**

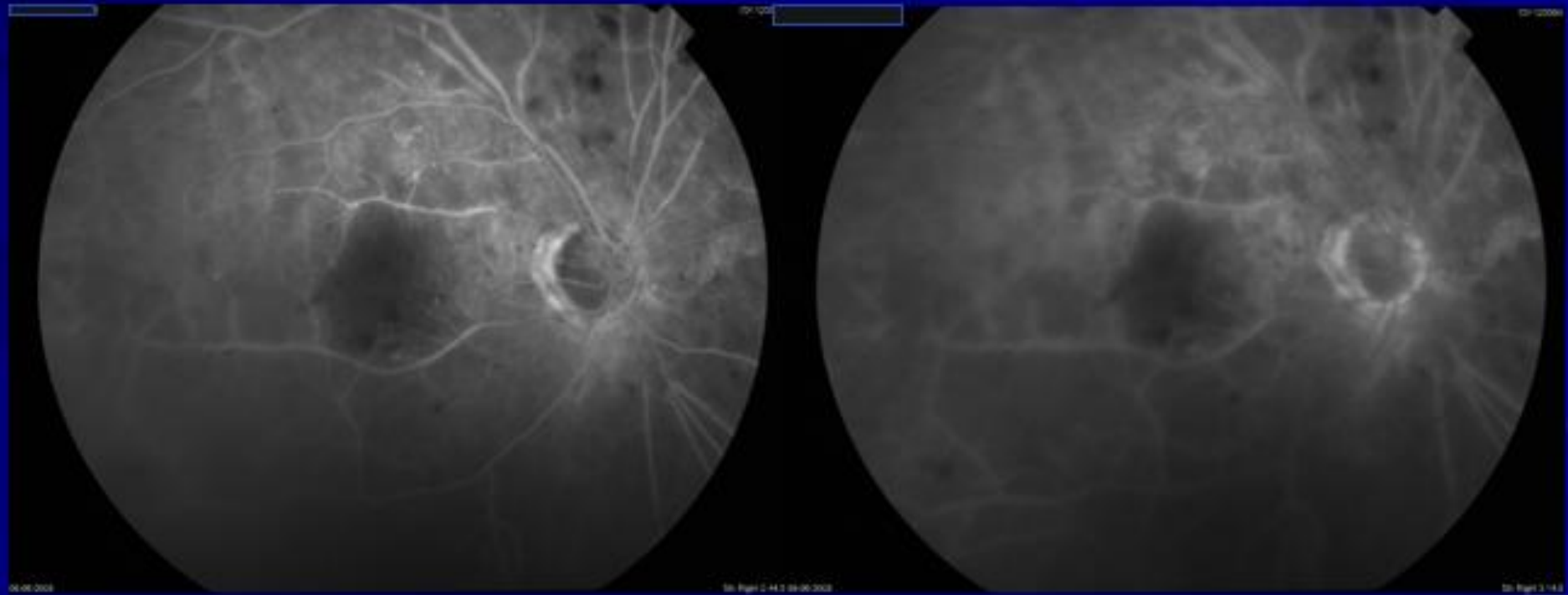


**Vision with Diabetic Retinopathy**





# Macular Ischemia can lead to profound vision loss



# Diabetic Retina Exam

- Slit-lamp examination (dilated eye exam)
- Optical Coherence tomography (OCT)
- Fluorescein angiography
- New technology
  - OCT-angiography (non-invasive angiography)
  - AI/Deep learning system

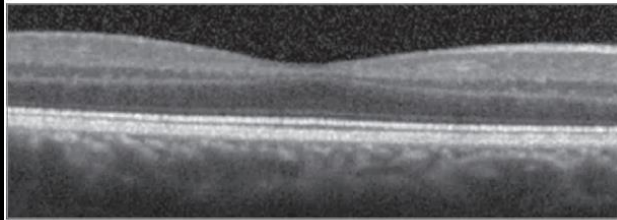
# Association Between Vessel Density and Visual Acuity in Patients With Diabetic Retinopathy and Poorly Controlled Type 1 Diabetes.

Bénédicte Dupas, MD; Wilfried Minvielle, MD; Sophie Bonnin, MD; Aude Couturier, MD; Ali Erginay, MD; Pascale Massin, MD, PhD; Alain Gaudric, MD; Ramin Tadayoni, MD, PhD

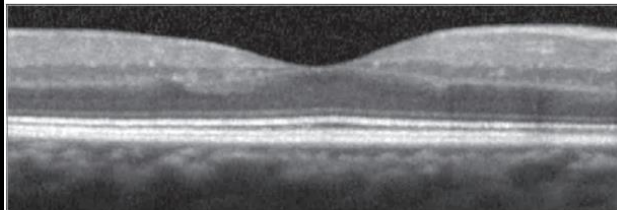
JAMA Ophthalmol. 2018;136(7):721-728. doi:10.1001/jamaophthalmol.2018.1319

**Figure 4. Optical Coherence Tomography in the Eyes of the Control Group and Patients With Diabetes**

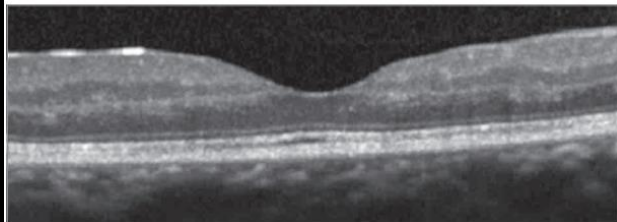
**A** Healthy eye, control group



**B** Eye with diabetic retinopathy and normal VA



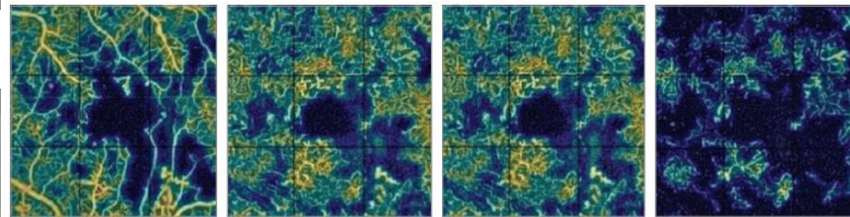
**C** Eye with diabetic retinopathy and decreased VA



Normal visual acuity (VA) represents 0 logMAR (Snellen equivalent, 20/20); decreased VA for the eye depicted represents 0.3 logMAR (Snellen equivalent, 20/40). Irregularities of the inner retinal layers are visible in all eyes with diabetic retinopathy; the stage is more advanced in the patient with the worst VA.

**Figure 3. Vessel Densities in Eyes of Patients With Diabetes and Decreased Visual Acuity**

**A** Superficial vascular plexus **B** Deep capillary complex **C** Intermediate capillary plexus **D** Deep capillary plexus



A vessel rarefaction is seen in all plexuses (A-D), but the deep capillary plexus (D) is strongly damaged because capillary nonperfusion areas are detected far outside the foveal avascular zone.

# Development and Validation of a Deep Learning System for Diabetic Retinopathy and Related Eye Diseases Using Retinal Images From Multiethnic Populations With Diabetes

Daniel Shu Wei Ting, MD, PhD; Carol Yim-Lui Cheung, PhD; Gilbert Lim, PhD; Gavin Siew Wei Tan, FRCSEd; Nguyen D. Quang, BEng; Alfred Gan, MSc; Haslina Hamzah, BSc; Renata Garcia-Franco, MD; Ian Yew San Yeo, FRCSEd; Shu Yen Lee, FRCSEd; Edmund Yick Mun Wong, FRCSEd; Charumathi Sabanayagam, MD, PhD; Mani Baskaran, MD, PhD; Farah Ibrahim, MB, BCh, BAO; Ngiap Chuan Tan, MCI, FAMS; Eric A. Finkelstein, MHA, PhD; Ecosse L. Lamoureux, PhD; Ian Y. Wong, FRCOph; Neil M. Bressler, MD; Sobha Sivaprasad, FRCOph; Rohit Varma, MD, MPH; Jost B. Jonas, MD, PhD; Ming Guang He, MD, PhD; Ching-Yu Cheng, MD, PhD; Gemmy Chui Ming Cheung, FRCOph; Tin Aung, MD, PhD; Wynne Hsu, PhD; Mong Li Lee, PhD; Tien Yin Wong, MD, PhD

JAMA 2017

71 896 images; 14 880 patients. DLS had

90.5% sensitivity and 91.6% specificity for detecting referable diabetic retinopathy;

100% sensitivity and 91.1% specificity for vision-threatening diabetic retinopathy;

96.4% sensitivity and 87.2% specificity for possible glaucoma;

93.2% sensitivity and 88.7% specificity for age-related macular degeneration, compared with professional graders.

Sensitivity – true positive rate (high sens = few false negatives)

Specificity – true negative rate (high spec = few false positives)

# DIABETIC RETINOPATHY TREATMENT

The best measure for prevention of loss of vision from diabetic retinopathy is strict glycemic control

# **The Effect of Intensive Diabetes Treatment On the Progression of Diabetic Retinopathy In Insulin-Dependent Diabetes Mellitus**

## ***The Diabetes Control and Complications Trial***

*The Diabetes Control and Complications Trial Research Group*

Intensive control reduced the risk of developing retinopathy by 76% and slowed progression of retinopathy by 54%; intensive control also reduced the risk of clinical neuropathy by 60% and albuminuria by 54%.

## **Primary prevention**

Strict glycemic control

Blood pressure control

## **Secondary prevention**

Annual eye exams

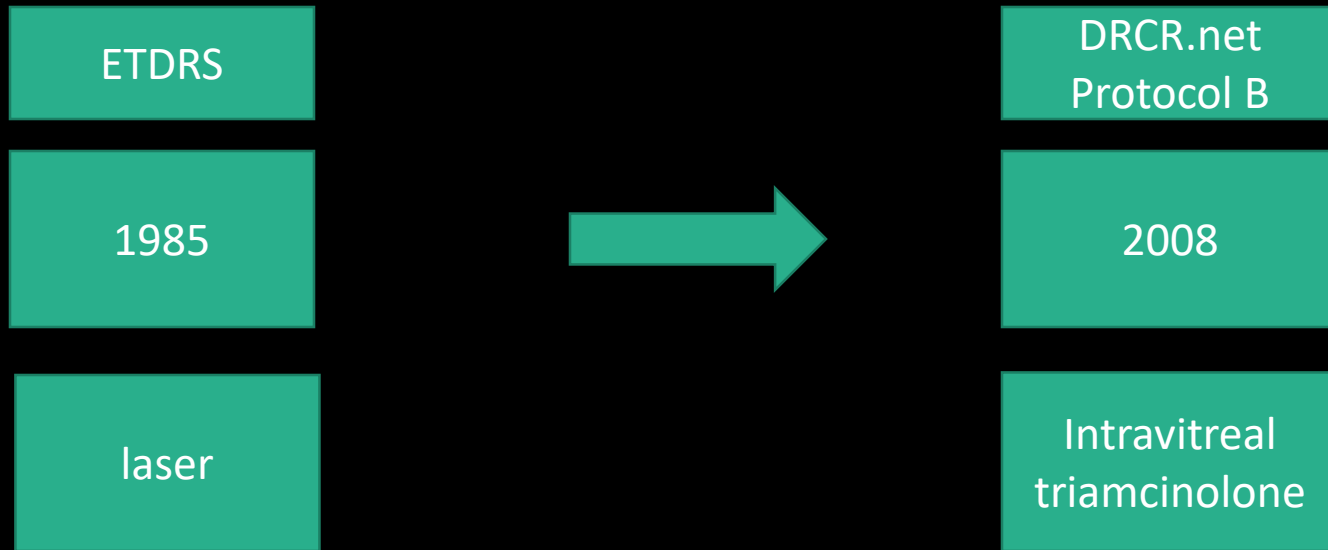
## **Tertiary prevention**

Retinal Laser photocoagulation

Anti-VEGF injections

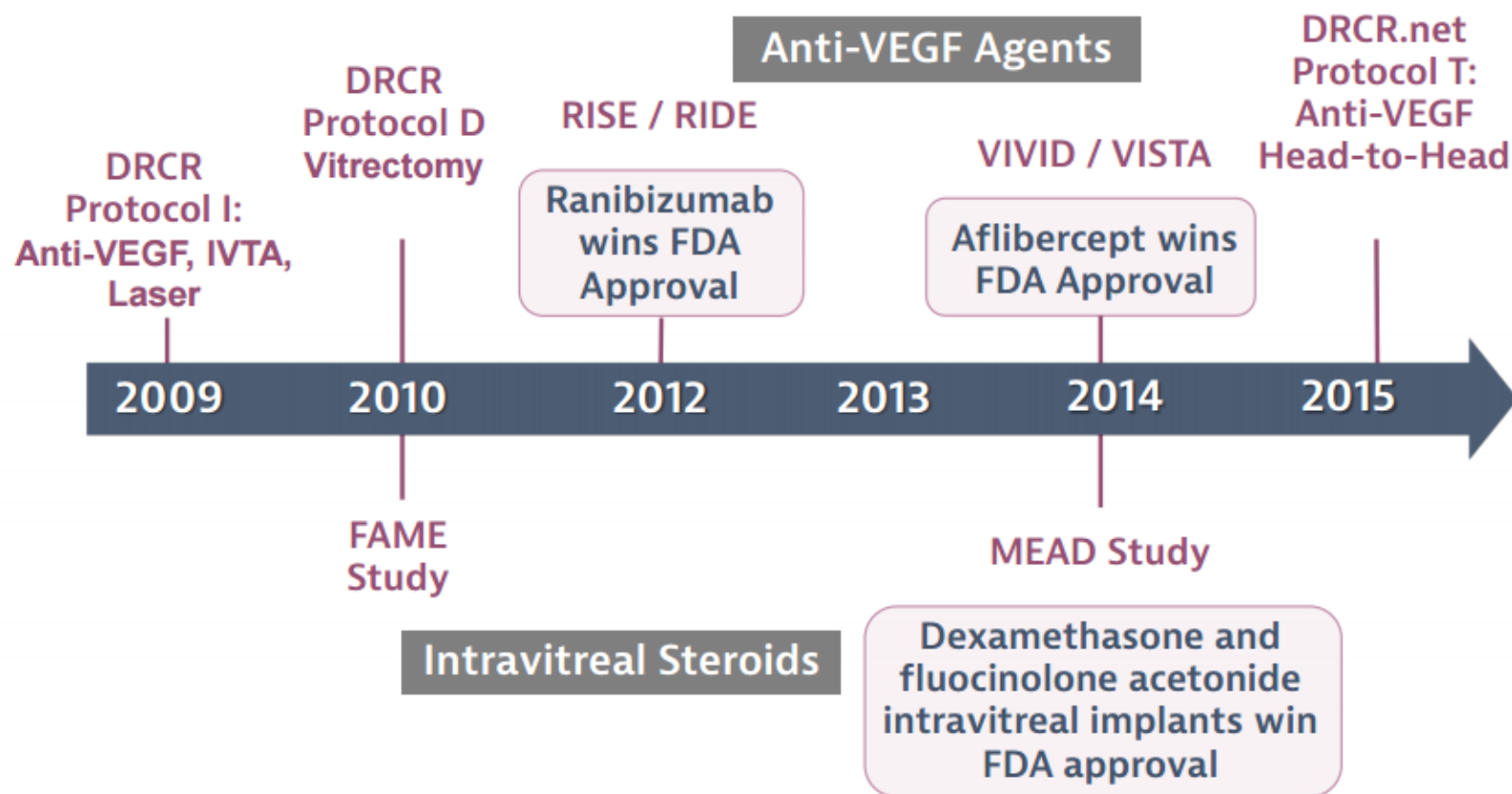
Vitrectomy

# Treatment Options





# Changing Treatment Paradigm for DME

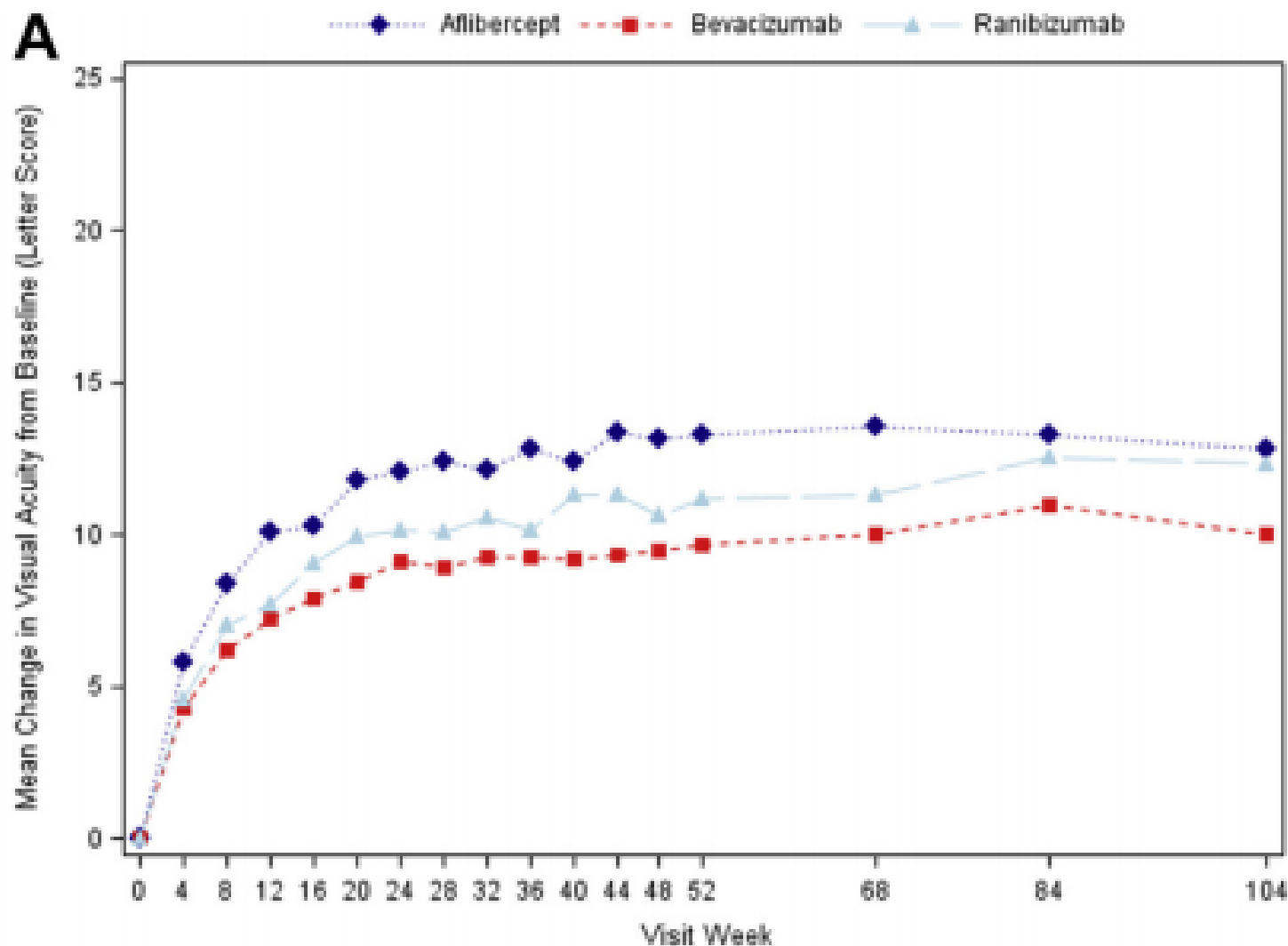


Campochiaro PA et al. *Ophthalmology*. 2010;117(7):1393-1399; Boyer DS et al. *Ophthalmology*. 2014; Haller JA et al. *Ophthalmology*. 2010;117(6):1087-1093; Diabetic Retinopathy Clinical Research Network. *Ophthalmology*. 2010;117(6):1064-1077; Nguyen QD et al. *Ophthalmology*. 2012;119(4):789-801; Korobelnik JF et al. *Ophthalmology*. 2014 Jul 8; DRCR.net

Protocol T DRCR.Net 2 year results

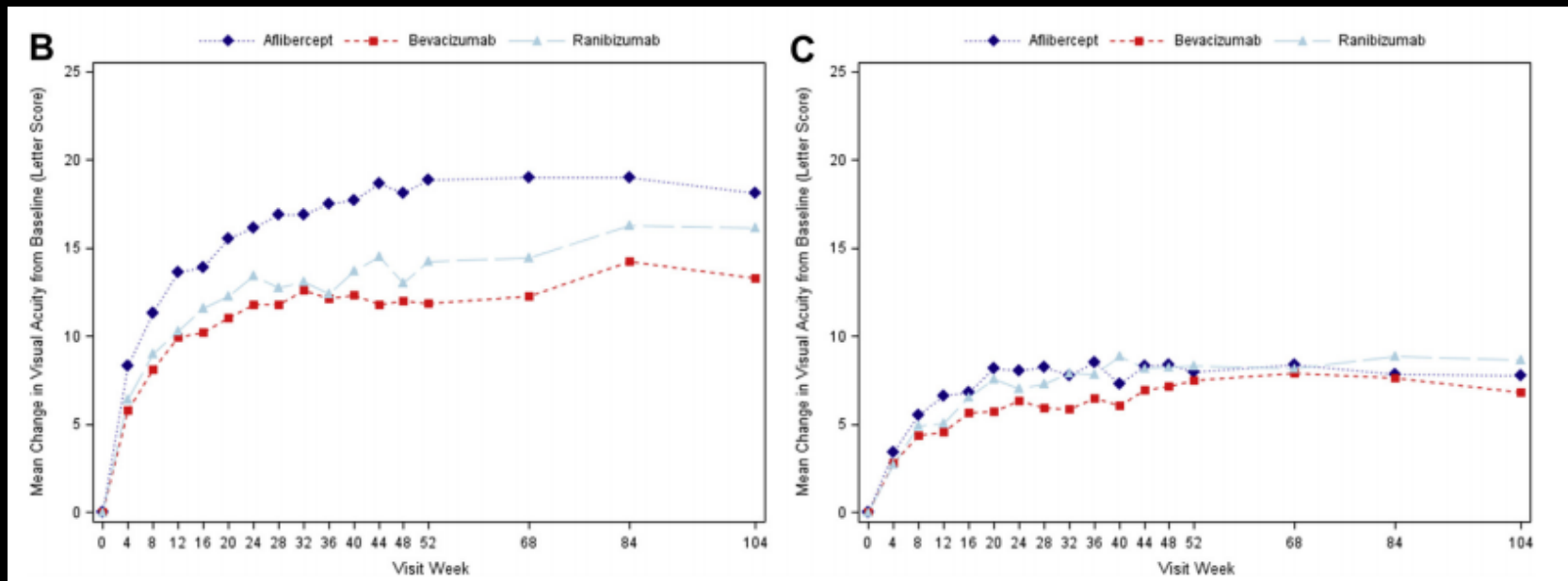
Aflibercept, Bevacizumab, or Ranibizumab for Diabetic Macular Edema Two-Year Results from a Comparative Effectiveness Randomized Clinical Trial

Wells JA, et al for the DRCR network Ophthalmology 2016



# Protocol T DRCR.Net

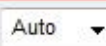
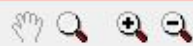
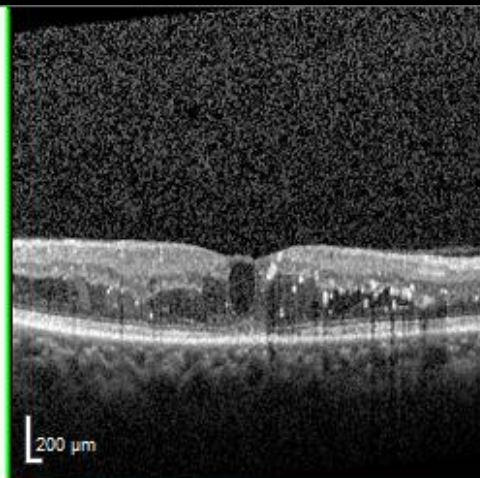
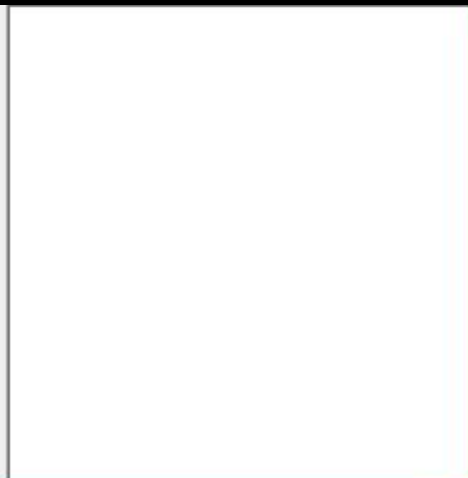
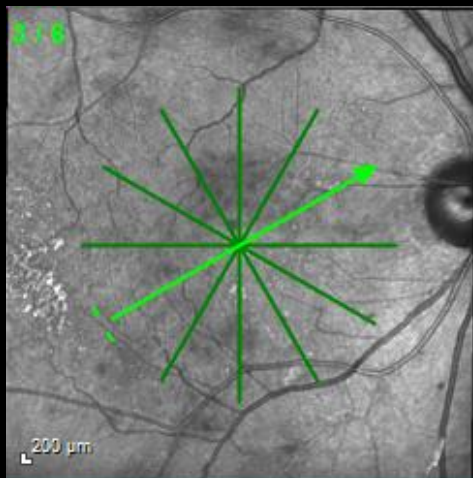
## 2 year results



Baseline VA: 20/50 or worse

Baseline VA: 20/32 to 20/40

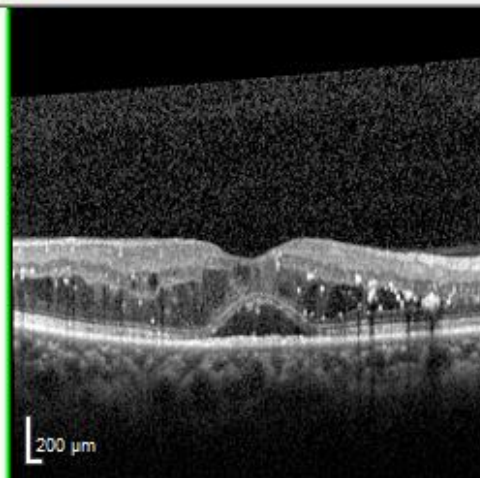
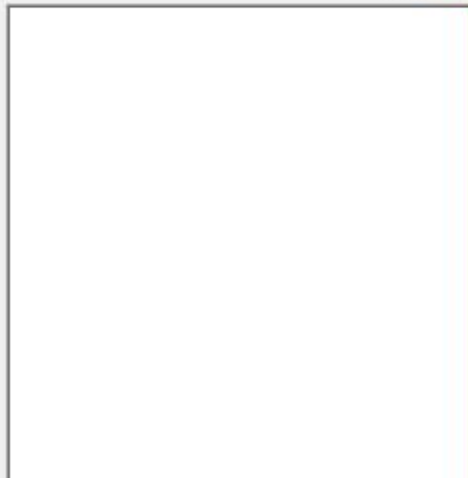
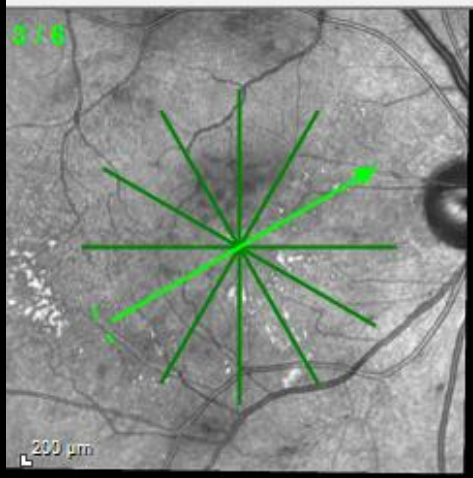
1 month after antiVEGF treatment



1:1 pixel

1:1  $\mu\text{m}$

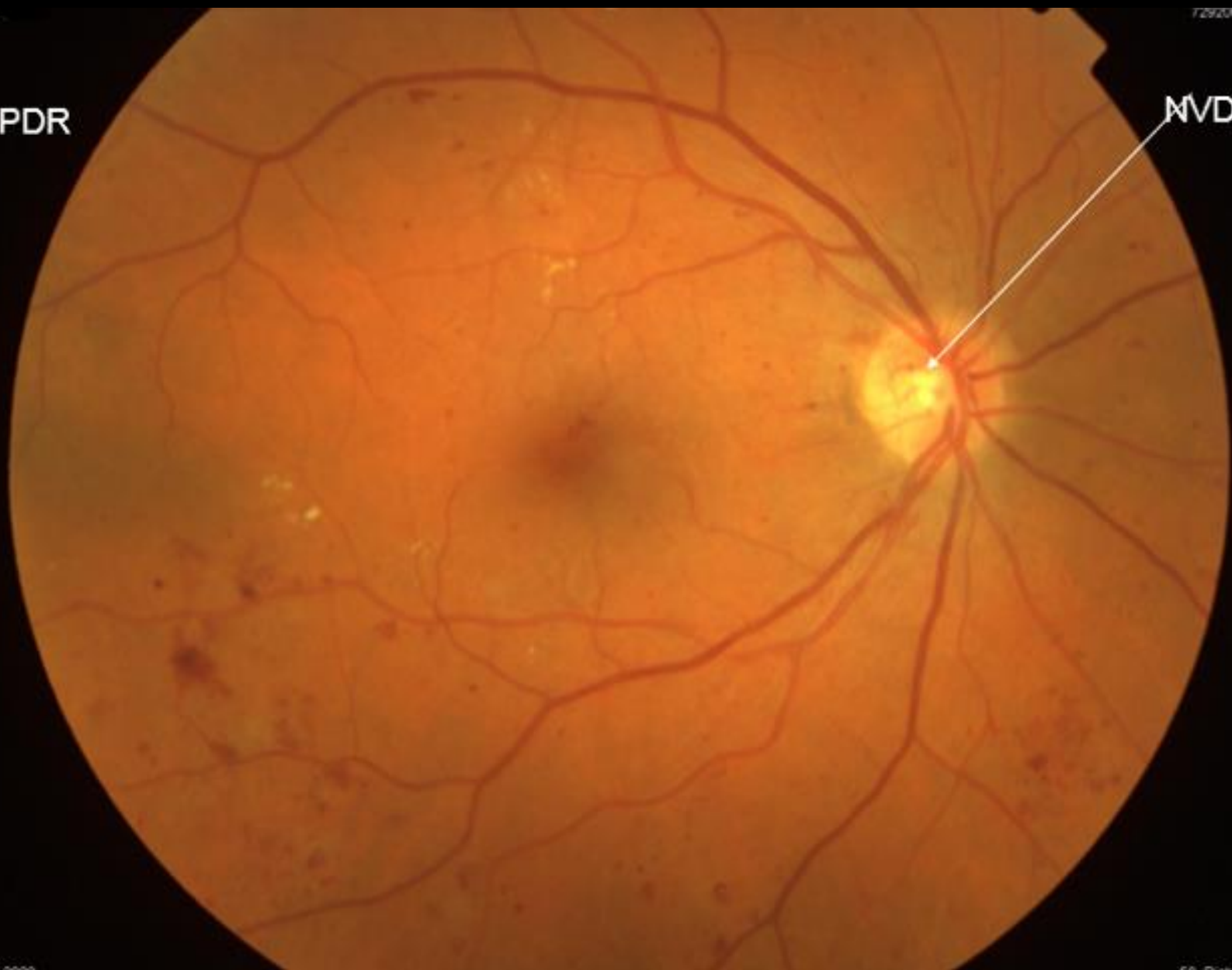
Reference: 9/13/2018



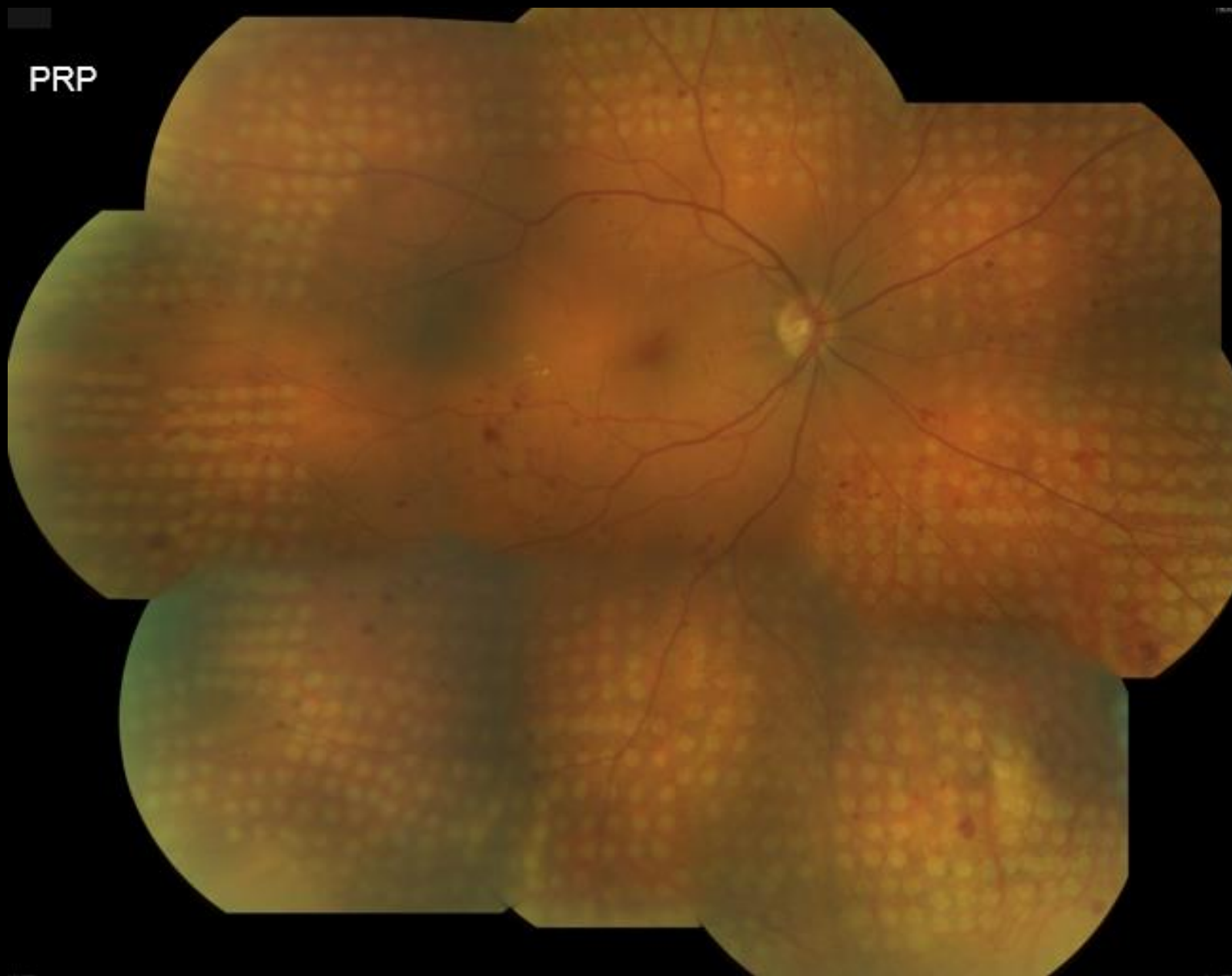
Examination: 8/9/2018

PDR

NVD



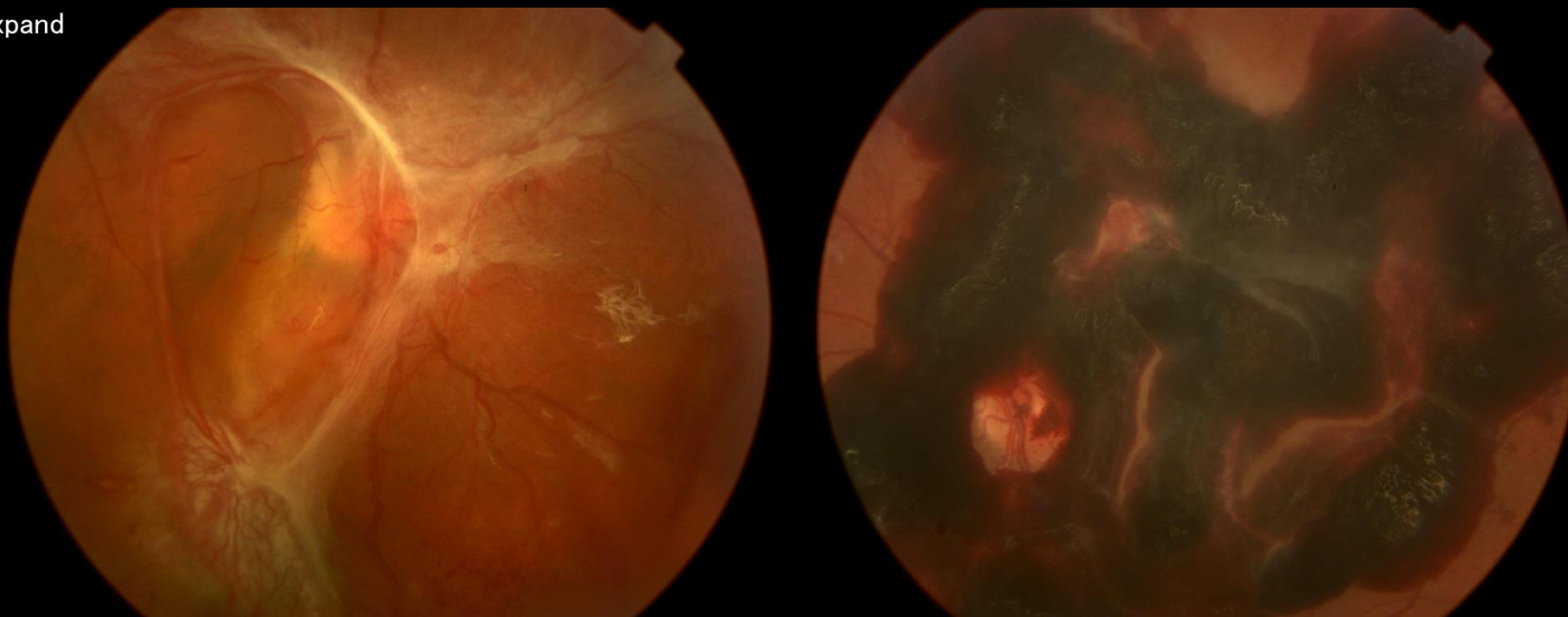
PRP





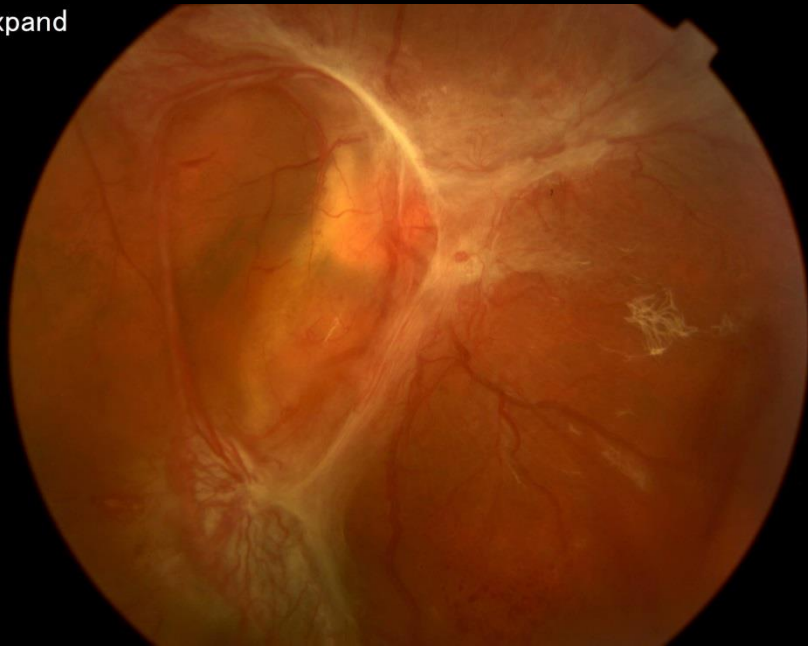
28 y.o WM with blurry vision right eye for 6 months, left eye for 1 week  
Diagnosed with DM 2 weeks ago  
Vision 20/400 OD; 20/200 OS

Expand

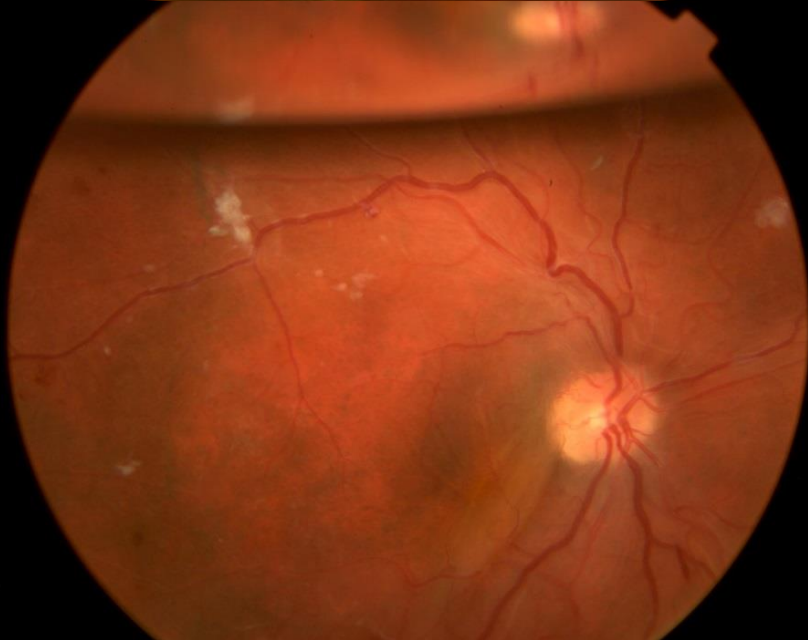
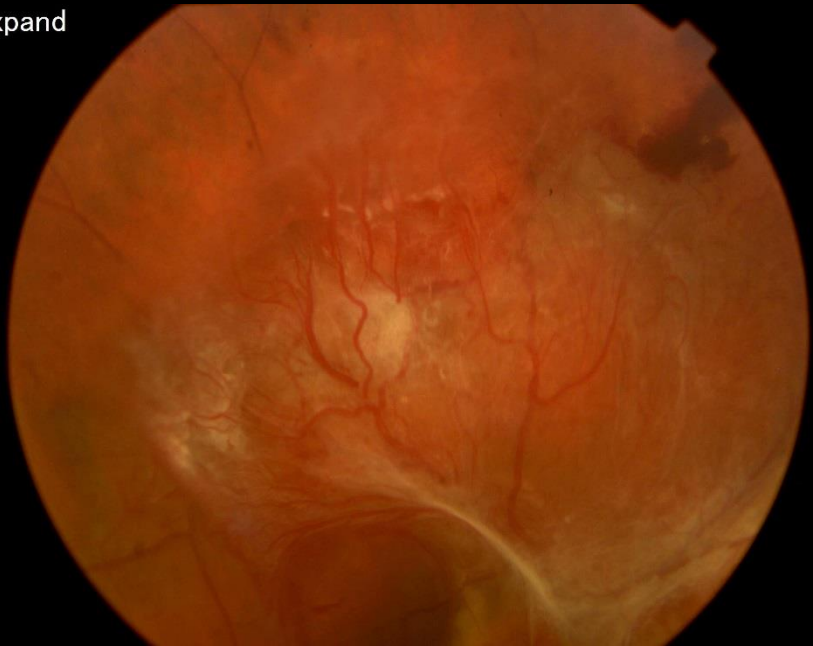


Plan: PRP Left eye same day  
Vitrectomy, membrane peel, laser, gas Right eye in 10 days

Expand



Expand





# Follow-up Guidelines

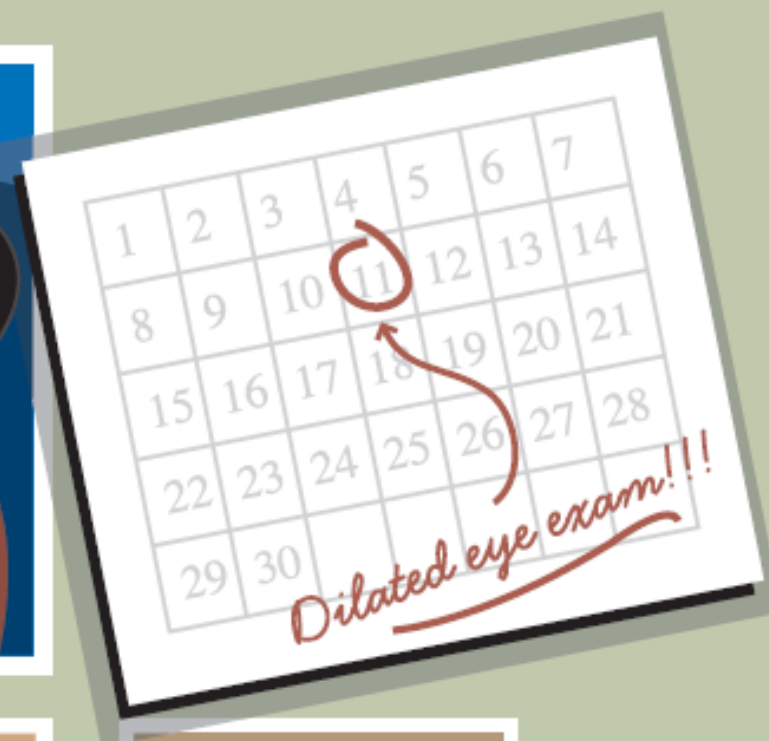
<b>Age of Onset</b>	<b>First Examination</b>	<b>Follow-up</b>
0 to 30 years (Type 1)	Within 5 years	Yearly
31 years and older (Type 2)	Upon diagnosis	Yearly
Prior to pregnancy (Type 1 or 2)	Prior to conception or early 1 <sup>st</sup> trimester	No retinopathy to mild-moderate NPDR: 3-12 months Severe NPDR or worse: 1-3 months
<b>Severity of Retinopathy</b>		
Diabetes only		Yearly
Mild-moderate NPDR		Every 6 months
Severe NPDR		Early 3-4 months
PDR		Every 3 months

# CONCLUSIONS



Diabetic Retinopathy is preventable through strict glycemic control and annual dilated eye exams by an ophthalmologist.

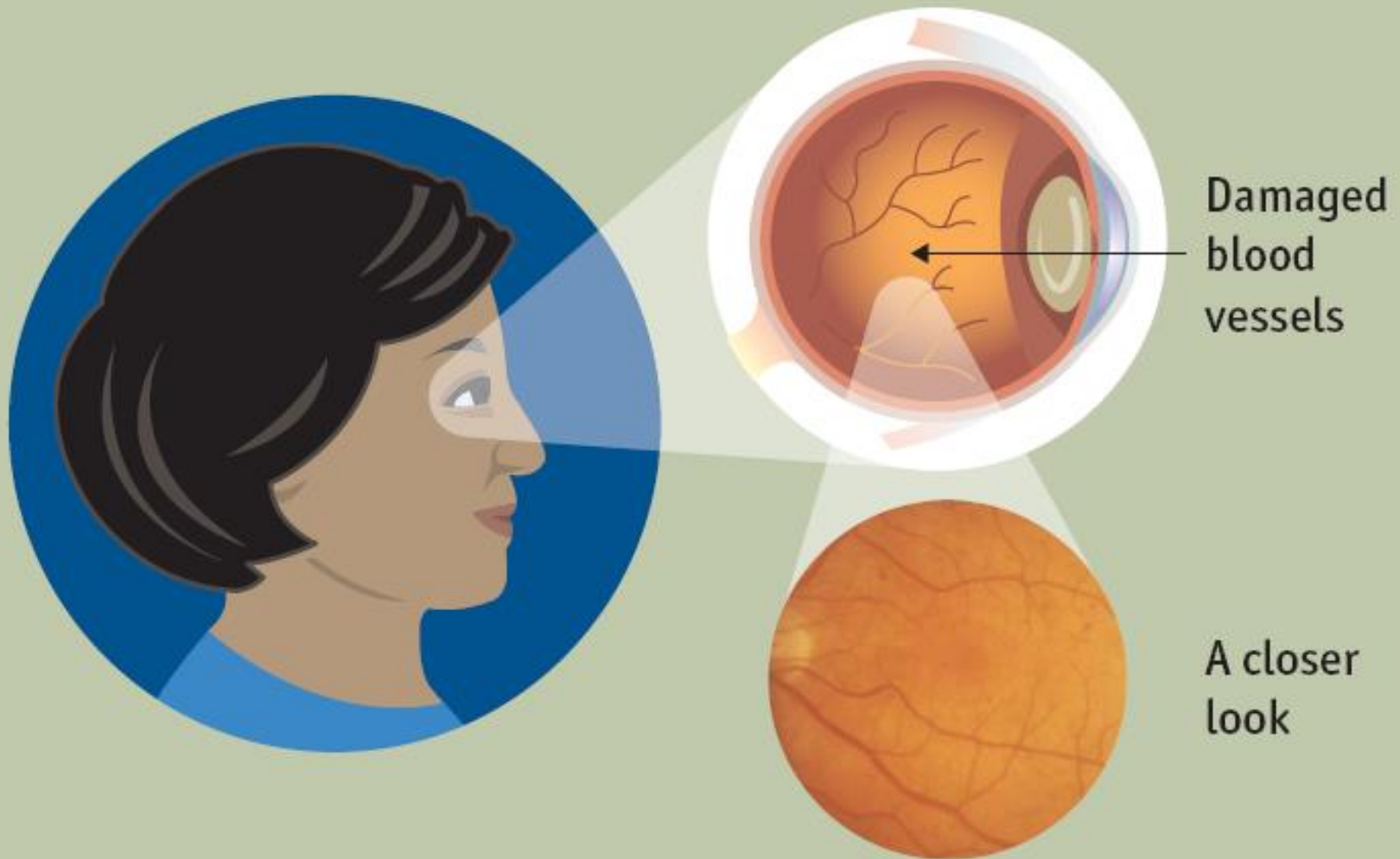
# People with diabetes need to know...



# Who can develop diabetic retinopathy?



# How does diabetes damage your eyes?





# How can diabetic retinopathy cause vision loss?



Left untreated,  
diabetic retinopathy  
can cause vision loss.

Diabetic retinopathy can damage  
your eyes even before you see  
changes in your vision.

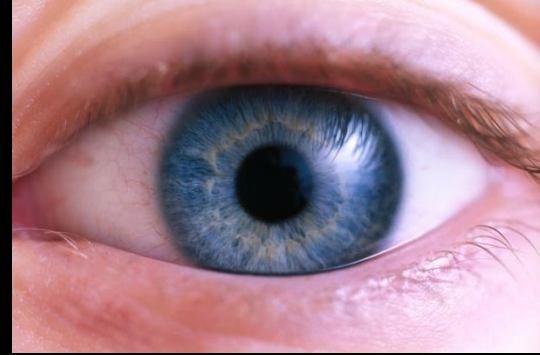


# Who is at risk for diabetic retinopathy?

- All people with diabetes
  - Type 1
  - AND Type 2
- During pregnancy, diabetic retinopathy may be a problem for women with diabetes.

Between 40 to 45 percent of Americans diagnosed with diabetes have some stage of diabetic retinopathy.

# ! Important !



- It is important to diagnose or catch diabetic retinopathy before symptoms occur!
- You may see great – and still have the early stages of diabetic retinopathy.

**Key is to catch and manage the disease early in its stages to preserve vision.**

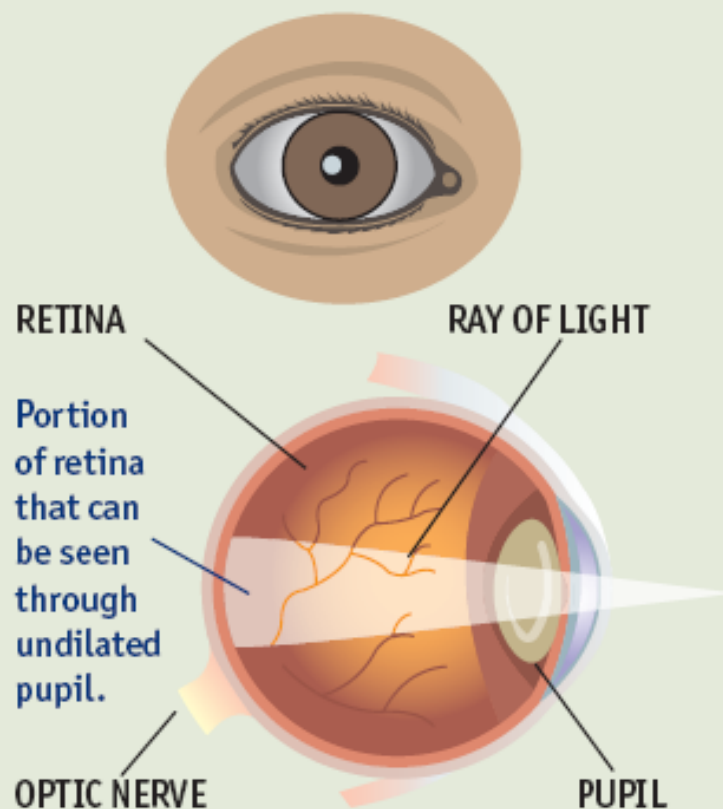


# Why is a dilated eye exam important?

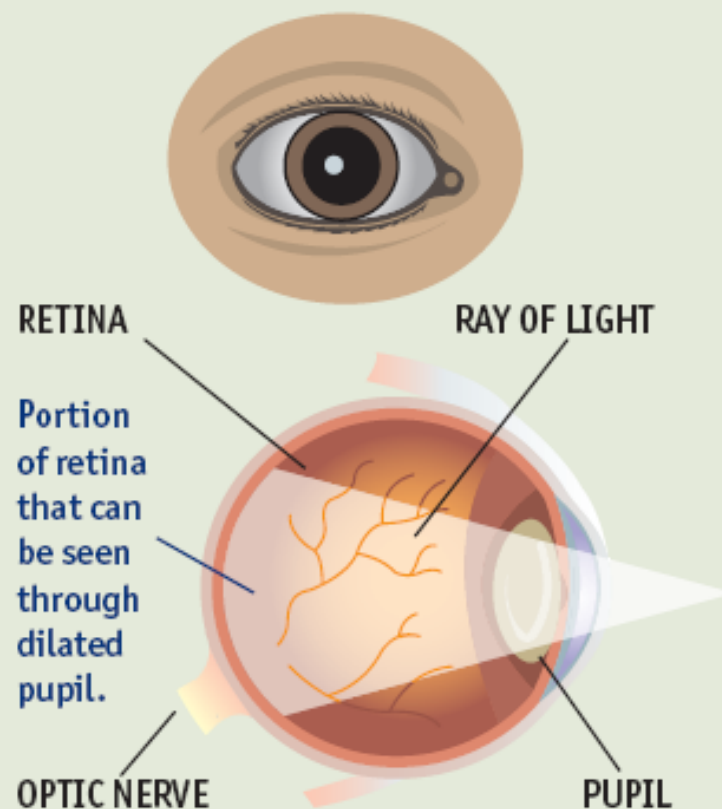


# What happens when you get a dilated eye exam?

## UNDILATED PUPIL



## DILATED PUPIL



# Risk factors Diabetic Retinopathy



Duration of diabetes is a major risk factor associated with the development of diabetic retinopathy

The severity of hyperglycemia is the key alterable risk factor associated with the development of diabetic retinopathy



# Diabetic Retinopathy

- Diabetes is the leading cause of blindness in patients aged 20-64 years.
- Patients can have severe diabetic retinopathy and still be asymptomatic. Early detection and treatment can help prevent vision loss.
- Regular exams, treatment guidelines for medical and surgical management of diabetic eye disease are capable of reducing the risk of severe vision loss and blindness by 90%
- Treatment options for diabetic macular edema and proliferative diabetic retinopathy include laser photocoagulation, intravitreal injection of steroid or anti-VEGF agents, and vitrectomy surgery.

- What is the most common cause of vision loss among working age adults in the United States?
- 1. Glaucoma
- 2. Cataract
- 3. Diabetic Retinopathy
- 4. Retinal Detachment

- The most common cause of moderate vision loss in diabetic retinopathy is:
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**A patient with Type II diabetes should get their first dilated eye exam:**

- 1. Only when the vision is affected**
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- 3. At the time of diagnosis of diabetes**
- 4. 1 year after the diagnosis of diabetes**

Thank you!

