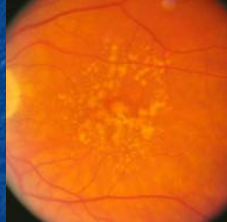
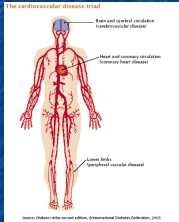


## AMD Update



Joseph J. Pizzimenti, OD, FAAO

## Financial Disclosures

- Honoraria
  - Review of Optometry
  - Optometric Management
  - Maculogix
- Paid Advisory Board Member
  - Zeiss
  - EyePromise/Zeavision
  - Genentech
  - Regeneron



## Financial Disclosures

- Proprietary Interests
  - None
- Consulting Fees
  - Zeiss
  - EyePromise/Zeavision
- Stockholder: Zeavision

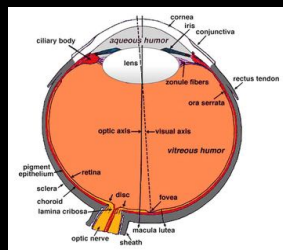


## E-Newsletter



OptometricRetinaSociety.org

Check out our E-newsletter



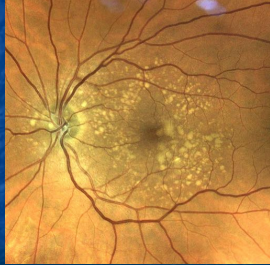
## QUESTIONS AND ANSWERS



Email me at [pizzimen@uiwtx.edu](mailto:pizzimen@uiwtx.edu)

## Course Goals

- To provide clinically useful information about AMD
- Systemic approach
  - Prevention
  - Early diagnosis
  - Treatment and management
  - **Nutrition**



## Statement of The Problem

- The AMD "Epidemic"
- AMD is the leading cause of blindness in individuals over the age of 50 in the developed world.

■ Klein R, Klein BEK, Linton KLP.  
Prevalence of age-related maculopathy.  
Ophthalmology. 1992;99:933-943.

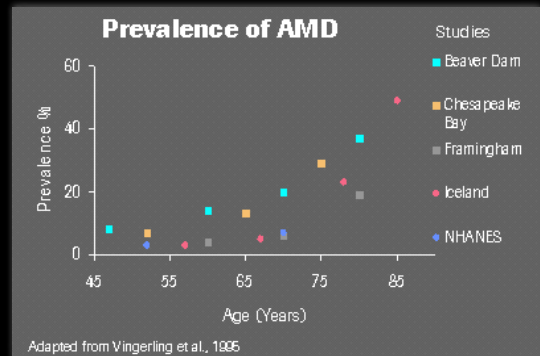


## What is AMD?

- AMD is a heterogeneous disorder affecting the RPE/Bruch's membrane/choriocapillaris complex.
- Early disease is **classically** characterized by minor vision loss associated with focal or diffuse sub-RPE debris and changes in RPE pigmentation.
- Late, advanced disease is characterized by severe vision loss associated with extensive RPE atrophy (GA) with or without the sequelae of macular neovascularization (MNV).

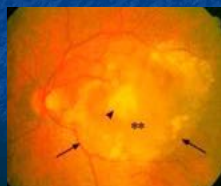
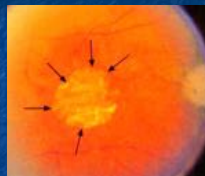
■ Zarbin MA. Age-related macular degeneration: review of pathogenesis. Eu J Ophthalmol. 1996;199-206.

## Epidemiology



## Classification of AMD

- **Non-neovascular, aka "dry"**
  - Non-exudative, atrophic
  - Can be performance-degrading
  - Majority of AMD cases
- **Neovascular, aka "wet"**
  - Exudative, hemorrhagic
  - **MNV** –devastating to central vision
  - Minority of AMD cases
    - Majority of vision loss



## The Burden of Disease





## The Burden of Severe Vision Loss in AMD

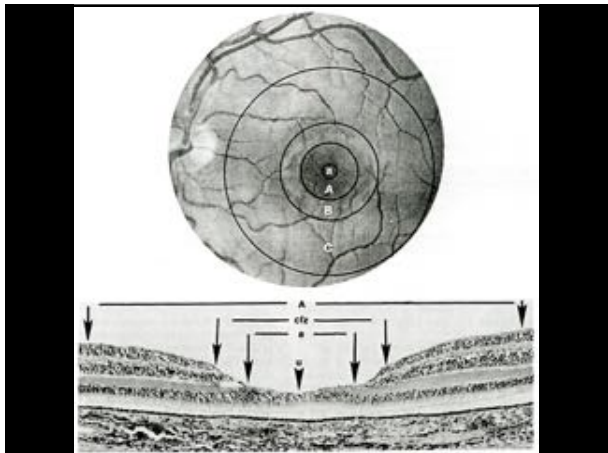
- Patients, loved ones, caregivers, medical community.
- Consequences may be:
  - Physical
  - Social- isolation
  - Economic
  - Psychological- depression



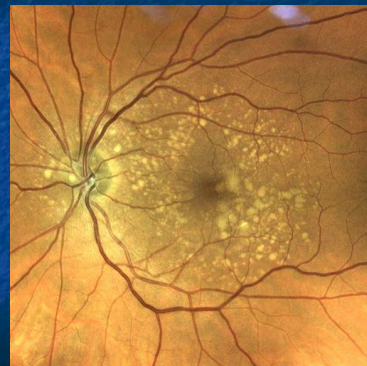
## The AMD “Epidemic”

*How should we as optometrists respond?*

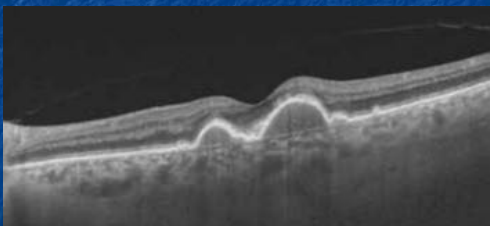
Prevention  
Early Diagnosis  
Early Intervention  
Improved Visual Outcomes



## Mixed Drusen



## OCT of Soft Drusen



## AMD Risk Factors

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>■ Non-modifiable                             <ul style="list-style-type: none"> <li>■ Age</li> <li>■ Heredity</li> <li>■ Sex (F&gt;M)</li> <li>■ Pigmentation</li> <li>■ Race</li> <li>■ Iris color</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>■ Modifiable                             <ul style="list-style-type: none"> <li>■ Smoking</li> <li>■ Cardiovascular disease</li> <li>■ Blood lipid status</li> <li>■ Hypertension</li> <li>■ Alcohol consumption</li> <li>■ Light exposure (UV, blue)</li> <li>■ Nutrition</li> <li>■ Obesity</li> <li>■ Low MPOD</li> <li>■ Poor dark adaptation</li> </ul> </li> </ul> |
|---|---|

# Macular Degeneration

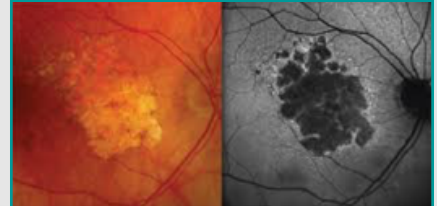
## Pathobiology of AMD

- Aging of the photoreceptors and RPE/Bruch
- Genetic component
- Environmental stress
  - Lifestyle/nutrition
  - Light-initiated oxidative damage



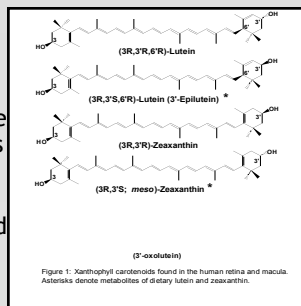
## What are the four primary retinal pigments?

- Zeaxanthin
- Lutein
  - along w/their metabolites, L & Z are found in the macula's sensory layers
- Melanin – found in the RPE
- Lipofuscin – found in the aging RPE



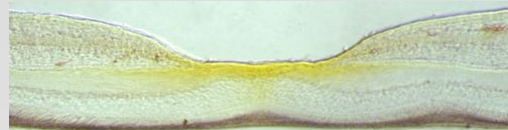
## Xanthophylls and AMD

- Lutein, zeaxanthin, and their metabolites help form the macular pigment.
- Dietary sources include green leafy vegetables and orange-yellow fruits.
- Act as antioxidants and blue light screening compounds.



## The Importance of Macular Pigment

- Filters blue light
- Acts as an antioxidant by quenching free radicals
- Provides support to sensory retina

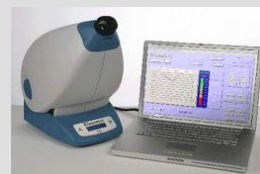


## Macular Pigment Optical Density (MPOD)

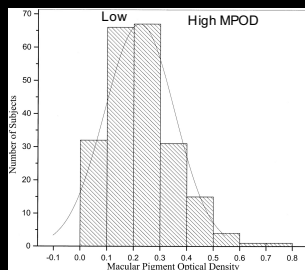
Heterochromatic Flicker Photometry (HFP)

## Risk assessment, early detection and monitoring of AMD

- Macular Pigment Optical Density
- MPOD



Macular Pigment Optical Density (du) ranges from 0.0-1.0



- 217 healthy subjects (79 men, 138 women) were recruited from the Phoenix metropolitan area (age range = 17–92 years).
- The average MPOD was  $0.22 \pm 0.13$ .
  - Investigative Ophthalmology & Visual Science May 2000, Vol. 41, 1492-1497.

MPOD is the IOP  
for  
AMD

## The Macula & Beyond: Value of MPOD

- AMD
- MacTel
- Type 2 DM, DR
- Obesity, smoking, heart dx
- Neurodegenerative disease
  - MS
  - Cognition including early AD
- Eye and brain development

• Demmig-Adams B, López-Pozo M, Stewart JJ, Adams WW III. Zeaxanthin and Lutein: Photoprotectors, Anti-Inflammatories, and Brain Food. *Molecules*. 2020; 25(16):3607. <https://doi.org/10.3390/molecules25163607>

• Gazzolo D, Picone S, Gaiuso A, Bellisato M, Montone G, Riccobene F, Lista G, Pellegrini G. Early Pediatric Benefit of Lutein for Maturing Eyes and Brain—An Overview. *Nutrients*. 2021; 13(9):3239. <https://doi.org/10.3390/nut13093239>

• Retina. September 2015 - Volume 35 - Issue 9 - p 1806-1816doi: 10.1097/IAE.0000000000000551

• Investigative Ophthalmology & Visual Science April 2015, Vol. 55, 1529-1535. doi:https://doi.org/10.1167/iov.17-22656

• Olivia M. Rifai, Sarah McGloay, Cason B. Robbins, Dilraj S. Grewal, Andy Liu, Sharon Fekrat, Thomas J. MacGillivray. The application of optical coherence tomography angiography in Alzheimer's disease: A systematic review. *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring*. 10.1002/dad2.12449, 13, 1, (2021).

## Benefits of Supplementation with Dietary Xanthophyll Carotenoids for People WITH OR WITHOUT AMD at Any Age

- Ocular structural and visual function development
- Ocular health and visual performance enhancement
- Brain development/health and cognitive performance
- Preserve retinal/macular health by improving MPOD, physiology
- Preserve cognitive health
- Preserve systemic vascular health (DM, CV)
- Blue light protection

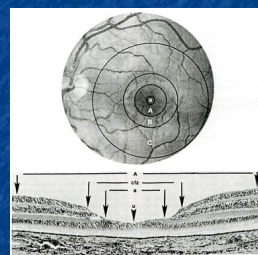
## MPOD Summary

- Macular Pigments are important photo-protectants and antioxidants.
- Low MPOD is a modifiable AMD risk factor.
- Increasing MPOD improves visual function and has additional health benefits.
- Measuring MPOD is fast, affordable, accurate, important.

[Vision Res. 2010 Mar 31; 50\(7\): 716-728.](#)

## A Rod-centric Model of Disease

- In maculae of healthy, young adults, rods outnumber cones by 9:1.
- Therefore, the macula may be described as cone-enriched but rod-dominated.
- In AMD, central rods die first, followed shortly by the nearby cones.





## A Rod-centric Model of Disease

Patients with **pre-AMD** often complain of difficulty with activities performed at night and under low illumination (e.g., driving, reading).

Mangione CM, Gutierrez PR, Lowe G, Ozay E, Seddon JM. Influence of age-related maculopathy on visual functioning and health-related quality of life. *Am J Ophthalmol*. 1999;128:45-53.

## Early Detection of Degenerative Change in "Subclinical AMD" or "Pre-AMD"

- DA measures the time for retinal adaptation after exposure to a light stimulus.
- Poor DA is a functional manifestation of early disease.
- **Rod intercept (RI) is analogous to A1C.**



Dark Adaptation (RI)  
is the  
A1C  
for AMD

Handheld Controller  
with Rechargeable Battery  
and USB-C Cable

AdaptDx<sup>TM</sup>  
PROx



Diopter Adjustments

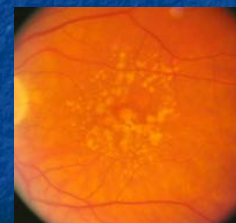
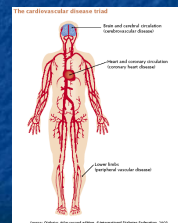
LCD Display

## QUESTIONS AND ANSWERS



Email me at [pizzimen@uiwtx.edu](mailto:pizzimen@uiwtx.edu)

## Emerging Trend: AMD as a Systemic Disease



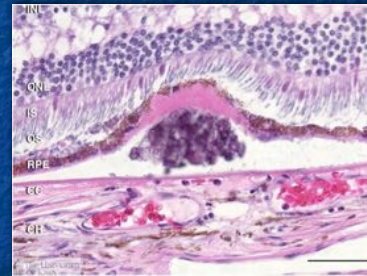
## AMD and Drusen

- AMD is a disease resulting from poor "Waste Management".



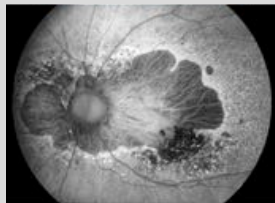
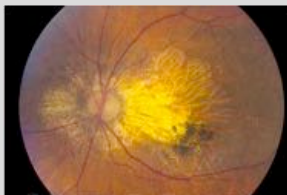
- Drusen are "pockets of inflammation"
  - Recent investigations show that proteins associated with inflammation and immune-mediated processes are prevalent in drusen.

## Drusen

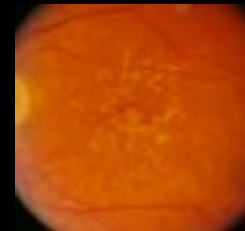
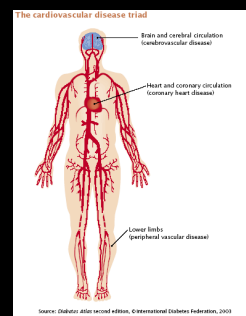


Drusen is the earliest clinically detectable feature of AMD.\*\*

## AMD: a sick eye in a sick body?



## AMD and Cardiovascular (Heart) Disease

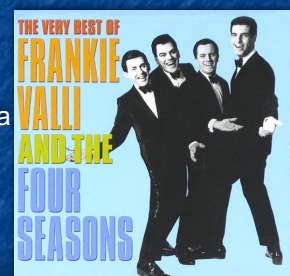


## Parallel Worlds: Heart Disease and AMD

- Diet – Low fruit/vegetable consumption increases risk of AMD and CVD
- Obesity and physical inactivity
- C-reactive protein (elevated)
  - Inflammatory marker
- Homocysteine (elevated)
- Omega-3 EFA may be beneficial for AMD patients
- Cholesterol (elevated)
- Serum Iron – Increased amounts may increase AMD and CVD

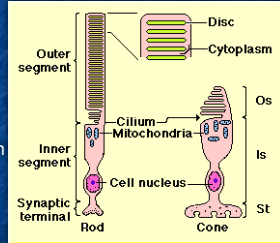
## The 4 Seasons of AMD

- Oxidation
- Inflammation/Ischemia
- Atrophy
- Neovascularization

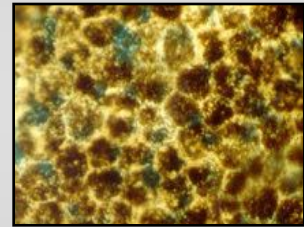
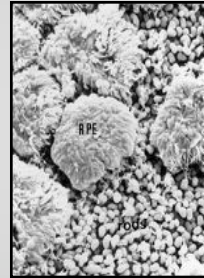


## Normal Retinal Metabolism

- Outer segment discs of rods and cones are transported to RPE for metabolism
- Discs are engulfed into RPE and fuse with lysosomes, where they are digested
- Undigested residual bodies remain as **lipofuscin**
  - These are the real troublemakers! \*



## Abnormal Retinal Metabolism

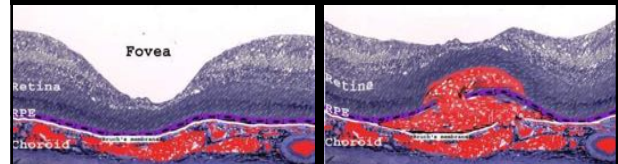


Lipofuscin accumulates in the aging RPE

## Reactive Oxygen Species (ROS)

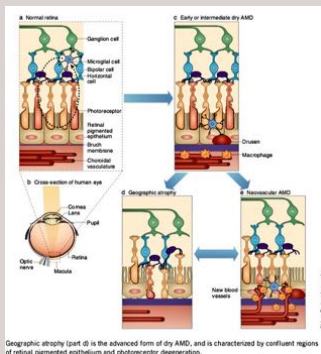
- ROS are the byproducts of oxygen metabolism
  - Free radicals
  - Hydrogen peroxide
  - Singlet oxygen
- The retina/macula is particularly susceptible to **oxidative stress** because of its high O-2 consumption and exposure to visible light.

## Wet AMD Pathology



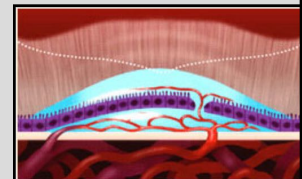
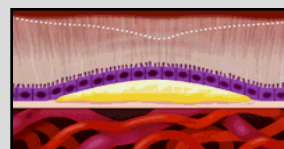
~20% of eyes w/dry AMD ultimately convert to wet AMD.\*

## Pathways in AMD Pathogenesis



## Pathogenesis of CNVM

- Breaks in Bruch's Theory
  - Diffuse thickening of Bruch's w/soft drusen
  - Predisposes Bruch's to breaks
  - New BV's from CC grow and proliferate





Advanced AMD starts out like this:



Large, ill-defined, and confluent soft drusen\*\*

## Intermediate Stage AMD

### • AREDS Category 3



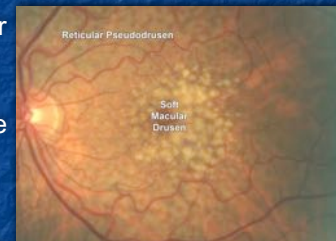
- Extensive intermediate drusen (63-124 $\mu$  diameter)
- At least one large druse (>125 $\mu$ )
- Geographic atrophy not involving the foveal center

Unfavorable prognostic signs leading to CNVM, GA:

- Soft, large, confluent drusen
- **Reticular (pseudo) drusen\***
- Focal hyperpigmentation
- Disciform lesion in the fellow eye
- Older age
- **Poor dark adaptation\***

## Reticular (Pseudo)drusen (RPD)

- Seen as a reticular pattern of small yellow-white lesions often in the superior macula, RPD are a high-risk sign for advanced AMD.



## Reticular (Pseudo)drusen



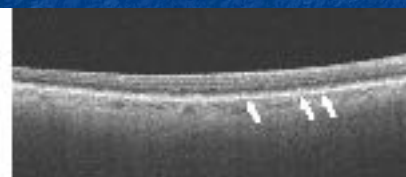
Reticular Drusen - Small Arrows  
Soft Drusen - Large Arrows

## Reticular (Pseudo)drusen

- Presence of RPD is a consistent risk factor for progression to both atrophy and CNV

■ IS/OS C-scan

B-scan



## Emerging Trend

- Home monitoring
- PHP
- OCT

The diagram illustrates the 'Emerging Trend' in home monitoring. It shows a 'Baseline' state with a normal OCT image and a 'Alert' state with a red OCT image indicating fluid. Below these, there are three OCT images labeled 'At-risk Fluid Overlay', 'Intraretinal Fluid Thickness Map', and 'Subretinal Fluid Thickness Map'. To the right, a small image of a patient using the device is shown.

## ForeseeHome™ AMD Monitoring Program

### The Monitoring Process

Patient uses the home monitor daily, just a few minutes per eye. Data is sent automatically after each test.

Uses ongoing monitoring by Retinal Vision Data Monitoring Center (RDMC).

Doctor can view data online at any time.

**ALERT!**  
RDMC notifies doctor → Schedule appointment

The diagram shows the 'Monitoring Process' for the ForeseeHome program. It includes a patient using the device, data being sent to the RDMC, and a doctor receiving an alert. A central diagram shows a 'WAVE' and a 'CENTER DOT'.

## Structure and Function

- OCT and PHP work synergistically

The diagram illustrates the 'Structure and Function' of the monitoring process. It shows two OCT images and a PHP image. The text indicates that 'OCT and PHP work synergistically'.

## Home OCT for Monitoring Therapy of nAMD Between Visits

- Monitoring of intra- and subretinal fluid based on daily patient self-imaging
- Easy-to-use, patient-operated device
- Takes less than one minute per eye
- AI algorithm analyzes images on cloud
- Remote diagnostic clinic, provider of monitoring program, reports changes meeting physician-selected fluid volume thresholds to referring physician
- 24/7 physician access to all data

The diagram shows the 'Home OCT Device' and the resulting 'Home OCT Image'. The text describes the device's capabilities and the monitoring process.

## Prevention and treatment of GA remains an unmet need.

The diagram shows a cross-section of the retina with arrows pointing to areas of degeneration. The text states that 'Prevention and treatment of GA remains an unmet need.'

Ultimate hope is that innovations such as complement inhibition and stem cell-based therapies provide an avenue for tissue regeneration or replacement.

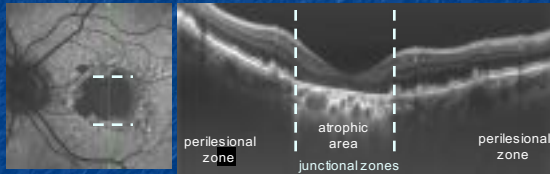
## FAF + OCT in GA

Offers a new perspective of the structure-function relationship within the retina

The diagram shows a cross-section of the retina with FAF and OCT images. The text states that 'FAF + OCT in GA' offers a new perspective of the structure-function relationship within the retina.

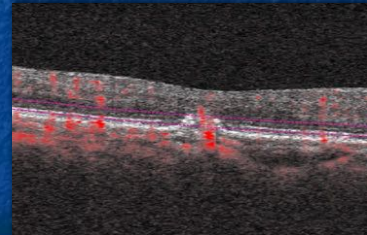
## Simultaneous FAF and OCT

### Geographic Atrophy



- FAF shows areas of hypo-autofluorescence in GA
- OCT outlines the corresponding photoreceptor dropout

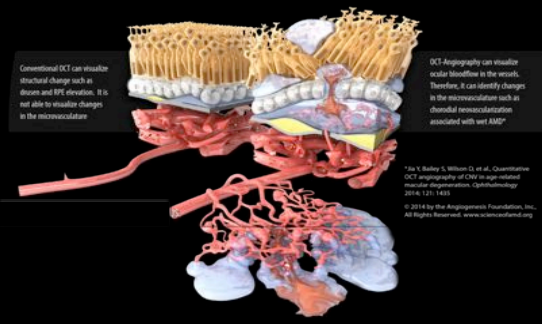
## Emerging Trend: OCTA



## THE ARRIVAL OF OCT-ANGIOGRAPHY (OCTA)

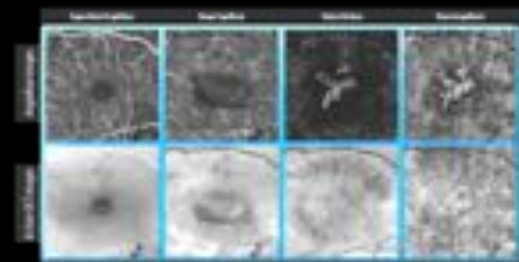
A new way of visualizing ocular bloodflow in the vessels—identifies retinal microcirculation using the intrinsic motion of blood cells in the vessel

- Enables immediate assessment of microcirculation in ocular diseases with unprecedented microvascular detail

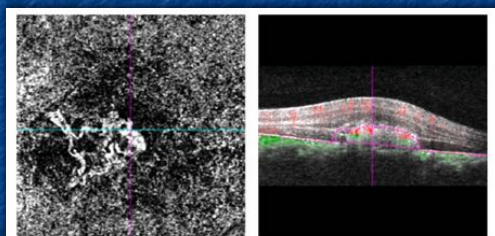


## Imaging

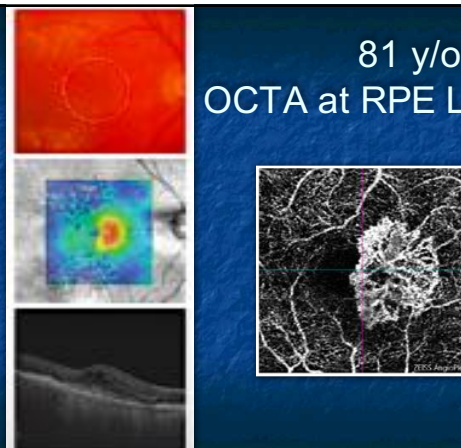
### OCTA IMAGES DEPICTING CHOROIDAL NEOVASCULARIZATION



## Cirrus Angioplex OCTA reveals CNV Lesion in nAMD

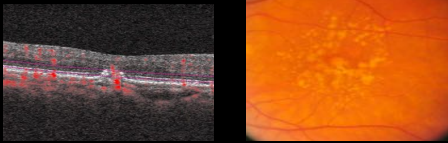


## 81 y/o WM OCTA at RPE Level

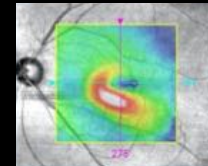
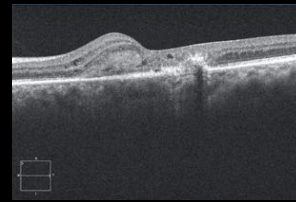
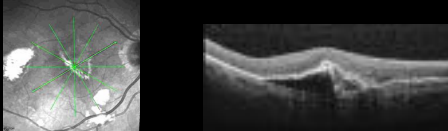




## Questions and Answers

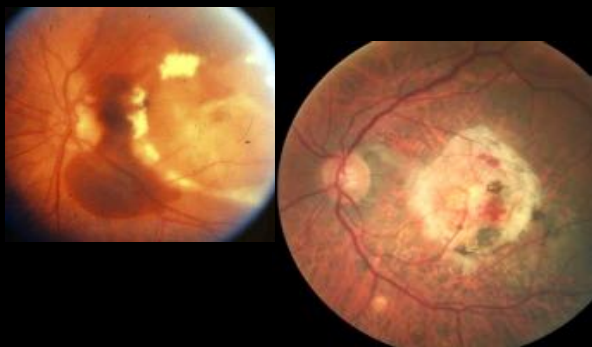


pizzimen@uiwtx.edu



## TREATMENT OF NEOVASCULAR AMD

## CNV ---> FV Scar



## 1980's – Thermal Laser Photocoagulation

- Very few patients suitable for treatment\*
- High recurrence rate (~50%)\*\*

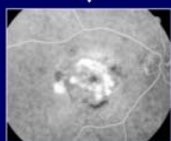


\* Freund KB, Yannuzzi LA, Sorenson JA. Am. J. Ophthalmol 1993; 115:786-791.  
 \*\* Macular Photocoagulation Study Group. Arch. Ophthalmol 1990; 108:825-831.

## 2000 – Photodynamic Therapy (PDT)

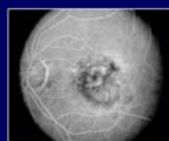
\*\*Advantage of PDT: less scarring than thermal laser\*\*

FDA-approved only for patients with subfoveal predominantly classic angiographic subtype

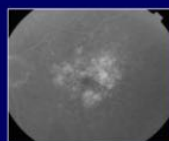


Predominantly classic  
25%

\*\*PDT scars less than thermal laser\*\*



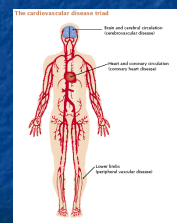
Minimally classic  
35%

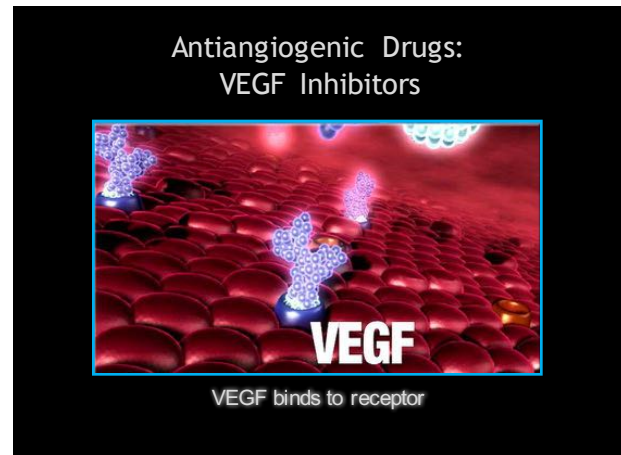
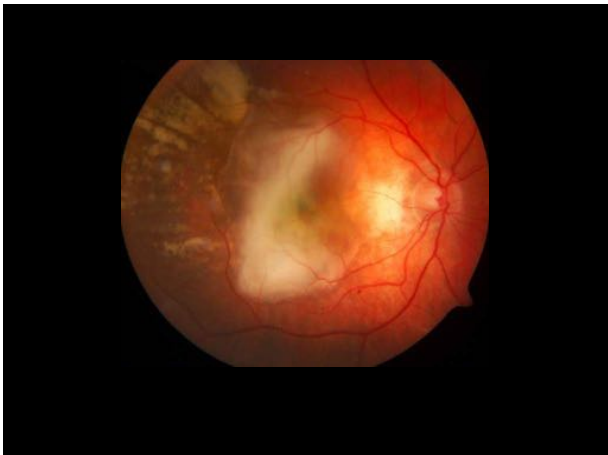
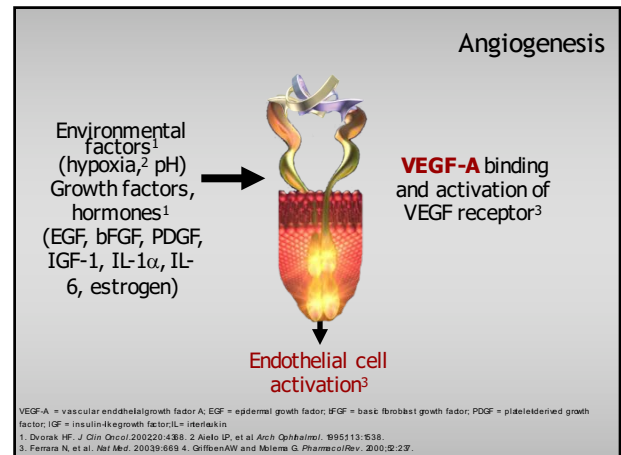
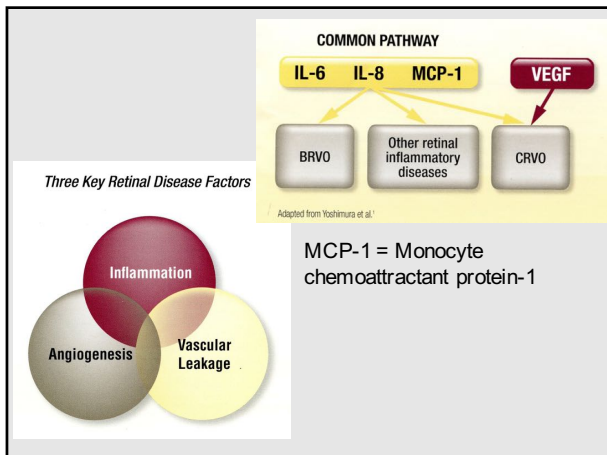


Occult with no classic  
40%

75% with no FDA-approved therapy

## Is AMD a Systemic Disease?





**Pegaptanib: An Anti-VEGF<sub>165</sub> Aptamer**

**Selective VEGF inhibition**

- Binds selectively to VEGF<sub>165</sub>
  - Pathologic isoform
  - Spares normal vasculature
- Dual mechanism
  - Anti-angiogenesis
  - Anti-permeability

**Pegaptanib binds to VEGF<sub>165</sub>**

**MACUGEN®**  
PEGAPTANIB SODIUM INJECTION

**AVASTIN (bevacizumab)**  
For Intravenous Use

**EYLEA 40 mg/ml**  
solution for injection in a vial  
Aflibercept  
Intravitreal use

**LUCENTIS (ranibizumab)**  
50 mg/0.5 mL solution for injection

~30% showed improved VA in ANCHOR, MARINA

## New Therapy with a Fraternal Name: Brolucizumab

- Humanized single-chain antibody fragment that inhibits all isoforms of VEGF-A.
- Phase III data from the HAWK and HARRIER trials.
- May allow for an extended interval between intravitreal injections for CNV, thus reducing the treatment burden.



## Brolucizumab

- CONTRAINDICATIONS**
  - Patients w/active intraocular inflammation.
- ADVERSE EFFECTS**
  - Retinal vasculitis and/or retinal vascular occlusion, typically in the presence of intraocular inflammation.
  - Patients should be instructed to report any change in vision without delay.



## Re(moving) the Needle Toward Sustained Delivery

- A novel Port Delivery System (PDS) with ranibizumab.
  - Approved in Dec 2021
- Permanent, refillable ocular implant.
  - Refills q6mon
- Holds 20 microliters of ranibizumab (100 mg/mL).
- ARCHWAY and PORTAL studies validate long-term safety and tolerability.



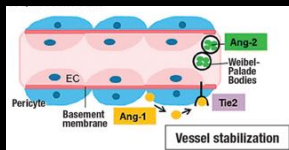
## Ranibizumab Injection for Susvimo Ocular Implant

- The device is placed through a 3.5-mm scleral incision in the pars plana.
- CONTRAINDICATIONS**
  - Patients with active intraocular inflammation.
- ADVERSE EVENTS**
  - Associated with 3-fold higher rate of endophthalmitis than monthly intravitreal injections of ranibizumab.



## Faricimab

- Bi-specific Ab that targets the VEGF and angiopoietin pathways.
  - VEGF and Ang-2 inhibitor
- There are 2 ligands, Ang-1 and Ang-2, and they both affect the Tie2 receptor. This receptor is critical for the stability of vascular tissue.
- In nAMD, Ang-2 is upregulated. This competes with the Ang-1-Tie2 signaling, causing vascular endothelial tight junction breakdown, as well as increased inflammation and MNV.



## Faricimab

- Phase 3 studies TENAYA and LUCERNE evaluated faricimab in nAMD.
- Both studies achieved visual outcomes with faricimab that were non-inferior to those of aflibercept (Eylea, Regeneron) injections q8wks.
- Also approved for DME.

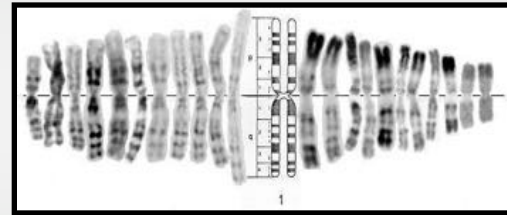




## Emerging Trend: Genetics and Genomics



## Genetics: ARMD-1



Chromosome 1  
Region Displayed: 1q25-q31

## Genetics and AMD

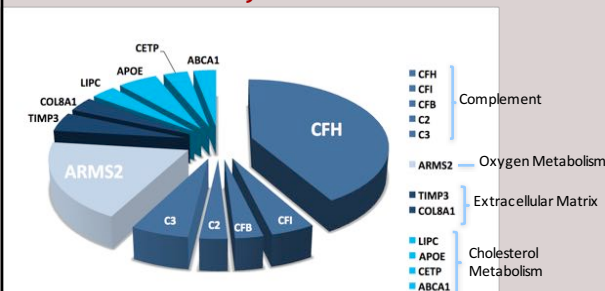
- Inherited variation in the **complement factor H** gene is a major risk factor for drusen.
- A single-nucleotide polymorphism (SNP) in the promoter region of **HTRA1** (a serine protease gene on chromosome 10q26) is a major risk factor for **nAMD**.
  - DeWan, A. Science, November 2006: Vol. 314. no. 5801, pp. 989 - 992

## Genetics and AMD

Naturally occurring variations conferring AMD risk

Marker	Allele	Odds Ratio	Freq
<b>CFH</b>	H1+H3 (risk)		0.202
	Average	>15	0.495
	(H1+H4)		0.303
<b>C3</b> rs2230199	G (risk)	2.6	0.18
	C		0.83
<b>ARMS2</b> rs10490924	T (risk)	8.2	0.17
	G		0.83
Smoking	Current (risk)	3.14	0.17
	Never		0.55
mt. A 4917G	G (risk)	2.2	0.09
	A		0.90

## Key AMD-associated Genes



## Example of Genomics

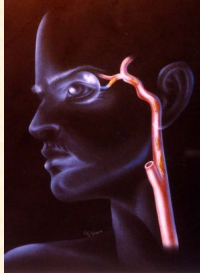
Smoking interacts with CFH Gene variants to increase AMD risk by 5X compared with genetically similar nonsmokers.



Am J Epidemiol. 2009 March 1; 169(5): 633-641.

## Cigarette Smoking, Ocular & Vascular Disease

- Increased arteriolar stiffness (sclerosis)
- Increased Vascular Endothelial Growth Factor (VEGF) production
- Development/worsening of DR
- Development/worsening of AMD



## AMD Gene Associations

- Mutations in the **TIMP3** gene
  - Metalloproteinase inhibitor 3 gene
- Two variants involved in the **HDL cholesterol** pathway.
  - Human hepatic lipase (LIPC) and cholesterol ester transfer protein (CETP).

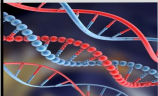
● Proceedings of the National Academy of Sciences (4/2010)

## Example of Genomics

A BMI over 30 increases AMD risk by 2.5X.

Clinical & Experimental  
Ophthalmology

Celebiler et al., J Clin Exp Ophthalmol 2012, 3:5



**IS AMD A NUTRITION-RESPONSIVE DISEASE?**

## AMD and Nutrition



"The **AREDS 1 Study** resulted in a formulation of vitamin C, beta carotene, zinc, and vitamin E that reduced the risk of progression of advanced disease by **25%** at 5 years."

Emily Chew, MD, from the National Eye Institute in Bethesda, Maryland

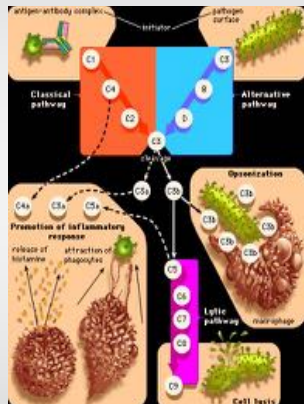
## Johanna Seddon, MD (Tufts U)

"Don't smoke; follow a healthful diet rich in dark green leafy vegetables and low in fat; eat fish a few times a week; maintain a normal weight and waist size; exercise regularly; and control blood pressure and cholesterol."



"Anyone with signs of intermediate-level macular degeneration in both eyes or advanced macular degeneration in one eye should also take dietary supplements that contain lutein, zeaxanthin, vitamin C, vitamin E, and zinc."

## The Complement Cascade: Inflammation



## AREDS 2



## AREDS 1 and 2 Formulations

- Vitamin C: 500 mg\*
- Vitamin E: 400 IU\*
- Beta-carotene: 15 mg (May be listed on the label as "25,000 IU vitamin A as beta-carotene") (eliminated)
  - Why?
- Zinc oxide: 80 mg (40 mg)
  - Why?
- Copper: 2 mg (needed to prevent Cu deficiency caused by high dosage of zinc)\*
- Lutein & Zeaxanthin (10 mg & 2 mg)
- Omega-3 fatty acids (1 gram)

## Study Subjects:

### AREDS 1 vs AREDS 2

- |                           |   |
|---------------------------|---|
| • All stages of AMD       | • More advanced stage                     |
| • Average age = 69        | • average age = 74                        |
| • 67% took Centrum (no L) | • 89% taking Centrum Silver (w/minimal L) |
| • Varied diets            | • diet high in carotenoids and vegetables |
| • Varied serum L and Z    | • higher serum L and Z                    |

These differences could impact the ability to detect a more significant reduction in progression!

## Evidence-based Advice for Patients

### AREDS-Established Risk Factors to Advanced AMD

- Increased risk for NV AMD: smokers, Caucasians
- Increased risk for CGA: smokers, those with a higher body mass index (AREDS-19)
- Higher intake of omega-3 long-chain polyunsaturated fatty acid (LCPUFA) and fish: associated with decreased likelihood of having NV AMD (AREDS-20)
- Higher dietary intake of lutein/zeaxanthin: associated with decreased likelihood of having NV AMD and GA (AREDS-22)
- Omega-3 LCPUFA intake: associated with a decreased risk of progression from bilateral drusen to CGA (AREDS-23)

Age-Related Eye Disease Study Research Group. Control Clin Trials. 1999;20(6):573-602.

## QUESTIONS?



pizzimen@uiwtx.edu



It would be naïve to assume that only 6 vitamins/nutrients are important in retinal health



## Emerging Trend: "Superfoods"

In AMD Prevention and Management



### Dietary Sources of Lutein/Zeaxanthin



### Dietary Lutein and Zeaxanthin: Eggs have high bioavailability



### Lutein



### Lutein



## Zeaxanthin



## Dietary Zeaxanthin: Gogi Berry



## Benefits of Supplementation with Dietary Xanthophyll Carotenoids for People WITH OR WITHOUT AMD at Any Age

- Ocular structural and visual function development
- Ocular health and visual performance enhancement
- Brain development/health and cognitive performance
- Preserve retinal/macular health by improving MPOD, physiology
- Preserve cognitive health
- Preserve systemic vascular health (DM, CV)
- Blue light protection

## Essential Fatty Acids (AMD, CVD, Stroke)



## Dietary Vitamin D: Cod Liver Oil, Sockeye Salmon

- Modulation of cell growth
- Neuromuscular and immune function
- Reduction of inflammation



**Vitamin D Deficiency**

90% Vitamin D from Sun Exposure

Diet provides only 10% of RDA of Vitamin D

**Winter Influenza**

**Cancer Belt:**  
Northern Latitudes  
Breast, Prostate, Uterine, Colon

**Obesity**  
Carbohydrate Craving

**Winter Depression**  
Seasonal Affective Disorder

**Loss of estrogen lowers Vitamin D**

**Osteoporosis**

**Low vitamin D**  
Hypertension  
Autoimmune Disease (Rheumatoid arthritis, Lupus)  
Organ Transplant Rejection

**Blacks need 10 times more sun**

**Sunlight in a bottle**  
4000 IU Needed

**Loss of muscle tone: heart failure, incontinence, falls**

Copyright 2005 Knowledge of Health Inc.

- For people aged one to 70 years, the RDA is at least 600 IU.
- For people over 70, RDA is at least 800 IU

#### Serum 25-Hydroxyvitamin D [25(OH)D] Concentrations and Health<sup>10</sup>

<12ng/mL	Deficiency, leading to rickets in infants and children and osteomalacia in adults
12-20ng/mL	Inadequate for bone and overall health in healthy individuals
>20ng/mL	Adequate for bone and overall health ←
>50ng/mL	Potential adverse effects

#### Sources of Vitamin D

Non-fat fortified milk	1 cup per day
Fish: salmon, tuna, codfish, mackerel, herring	at least three servings per week
"Sensible sunlight"	Five to 15 minutes, two to five times per week
Vitamin D3 supplements	1,000 IU per day

## Phototrop Study

- Improvement of Visual Function and Fundus Alterations in Early AMD Treated With a Combination of Acetyl-L-Carnitine, n-3 Fatty Acids, and CoQ10
  - Feher, et.al.
  - *Ophthalmologica*:2005;219:154-166
- 160 early AMD subjects randomized to Tx and controls
- 12 months
- VFMD, foveal sensitivity
- ETDRS VA, fundus exam
- All 4 parameters showed statistically significant improvement
- Principle: improved mitochondrial lipid metabolism

## CoQ10

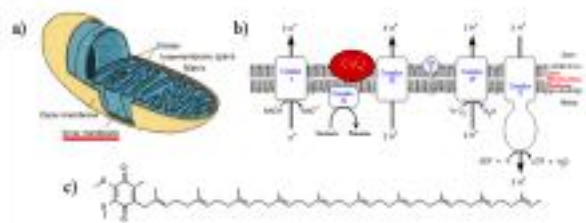


Figure 1. CoQ<sub>10</sub> is an essential component of the electron transport chain within the mitochondria.<sup>12</sup>

## Flavonoids are Anti-oxidants, CA Fighters



## B-carotene, L, and Z



## Not-so-guilty Pleasures

- Walnuts favorably affect cholesterol levels, reduce risk of heart disease.
- Dark chocolate, red wine are rich in antioxidants.
- Resveratrol enhances circulatory health (blood flow) and may have benefits in certain types of cancer.





## Folic Acid, B<sub>6</sub>, B<sub>12</sub>

- Folic Acid, Pyridoxine, and Cyanocobalamin Combination Treatment and Age-Related Macular Degeneration in Women: The Women's Antioxidant and Folic Acid Cardiovascular Study

● William G. Christen, ScD; Robert J. Glynn, ScD; Emily Y. Chew, MD; Christine M. Albert, MD; JoAnn E. Manson, MD

● *Arch Intern Med.* 2009;169(4):335-341.

## Folic Acid, B<sub>6</sub>, B<sub>12</sub> in Foods



## Folic Acid, B<sub>6</sub>, B<sub>12</sub>

- 5442 female health care professionals 40 years or older with pre-existing CV disease
- Randomly assigned to receive a combination of folic acid (2.5 mg/d), pyridoxine hydrochloride (50 mg/d), and cyanocobalamin (1 mg/d) or placebo.
- After an average of 7.3 years of treatment and follow-up, there were **55 cases of AMD in the combination treatment group and 82 in the placebo group** (relative risk, 0.66; 95% confidence interval, 0.47-0.93 [ $P = .02$ ]).

## Behavior Modification

- Physical activity
- Fish consumption
- Greens
- Smaller portions
- Alcohol in moderation
- Nutritional supplements
- Blocking blue light from reaching retina



## Behavior Modification

- Sedentary lifestyle
- Smoking
- Excess Alcohol
- High BMI
- HTN, Cholesterol
- Diet low in fish, green veggies



## Conclusions

- AMD is on the rise, and it has systemic comorbidities and implications.
- Diet, nutrition, lifestyle matter.
- We must take proactive steps on behalf of our patients.



Thank you!

Joe