Teleretinal Imaging at the Indian Health Service: Past, Present and the AI Future

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What is diabetic retinopathy?

Diabetic retinopathy occurs when high BS damages the blood vessels in the back of the eye.

Who develops it?

Diabetic patients who have elevated blood sugar for years

What else contributes?

For patients with HTN, high lipids and kidney disease, the DR is worse.

FACTS ABOUT DIABETES

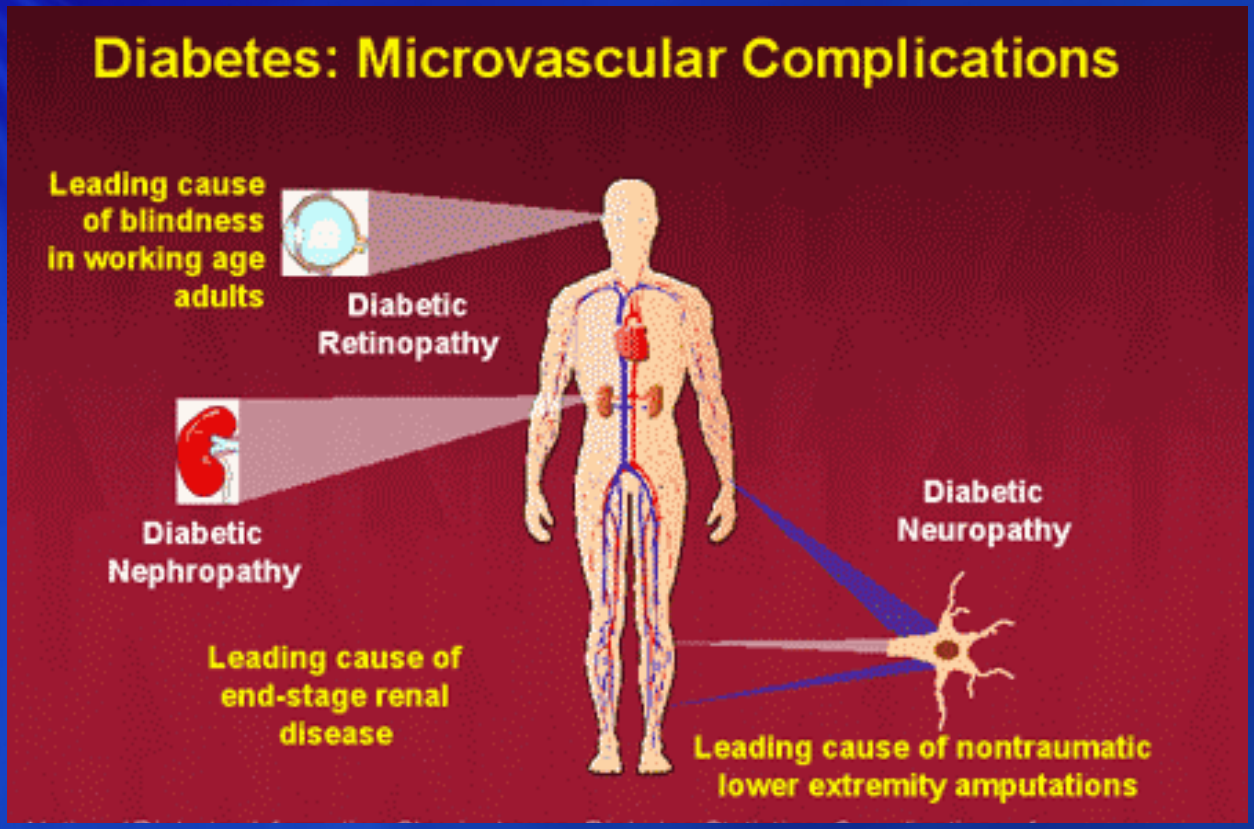
Most diabetics eventually develop retinopathy

Diabetic Retinopathy is the leading cause of new blindness in adults

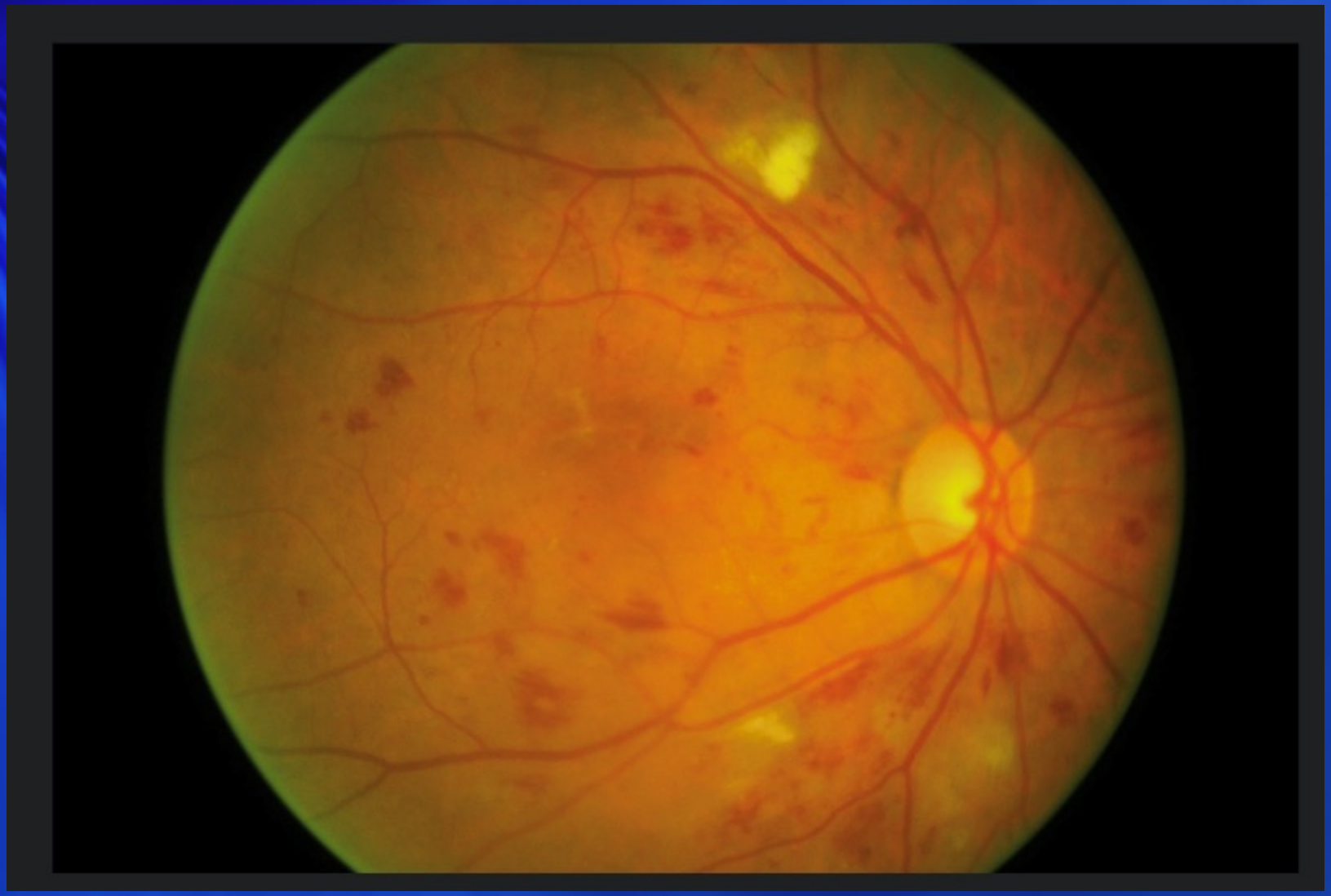
Blindness due to diabetes can be prevented by timely diagnosis and treatment

Diabetes affects blood vessels, small and large

The most common small blood vessel complication is diabetic retinopathy



What does diabetic retinopathy look like?



Stages of Diabetic Retinopathy

High blood sugar damages blood vessels in the back of the eyes

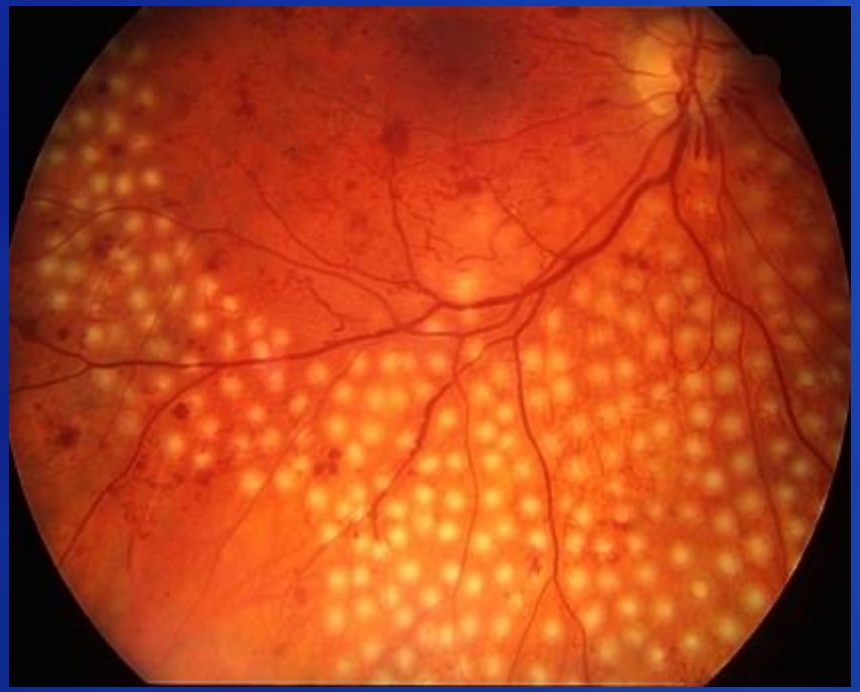
Poster developed by the Phoenix Indian Medical Center Department of Ophthalmology and the Office of Community Relations

What problems do abnormal blood vessels cause in the retina?

- Damaged blood vessels produce vascular growth factors called VEGF
- VEGF is the most important factor leading to advanced DR and swelling in the retina
- Anti-VEGF injections treat advanced DR and swelling

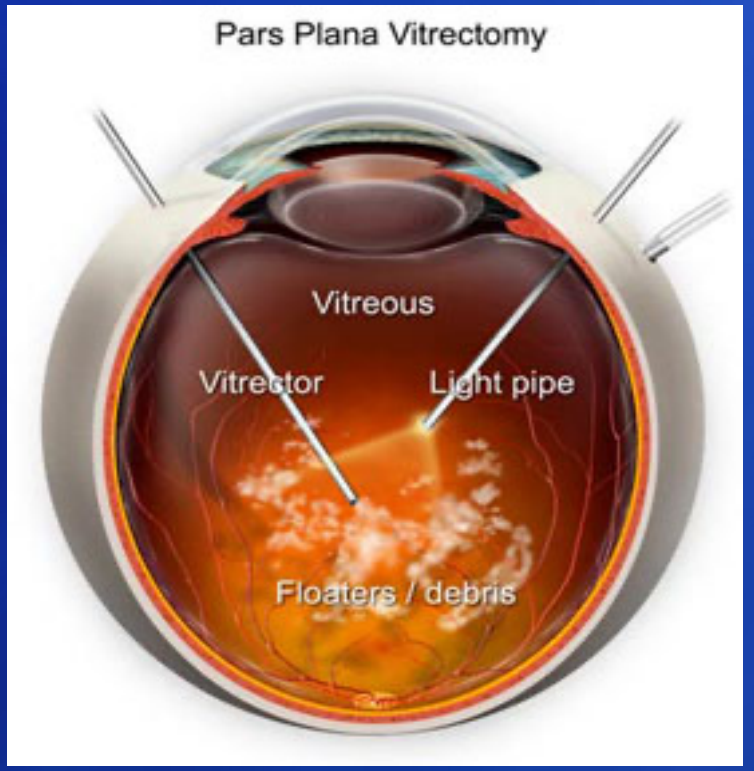
LASER TREATMENT

Decreases VEGF levels and reduces the risk of severe vision loss

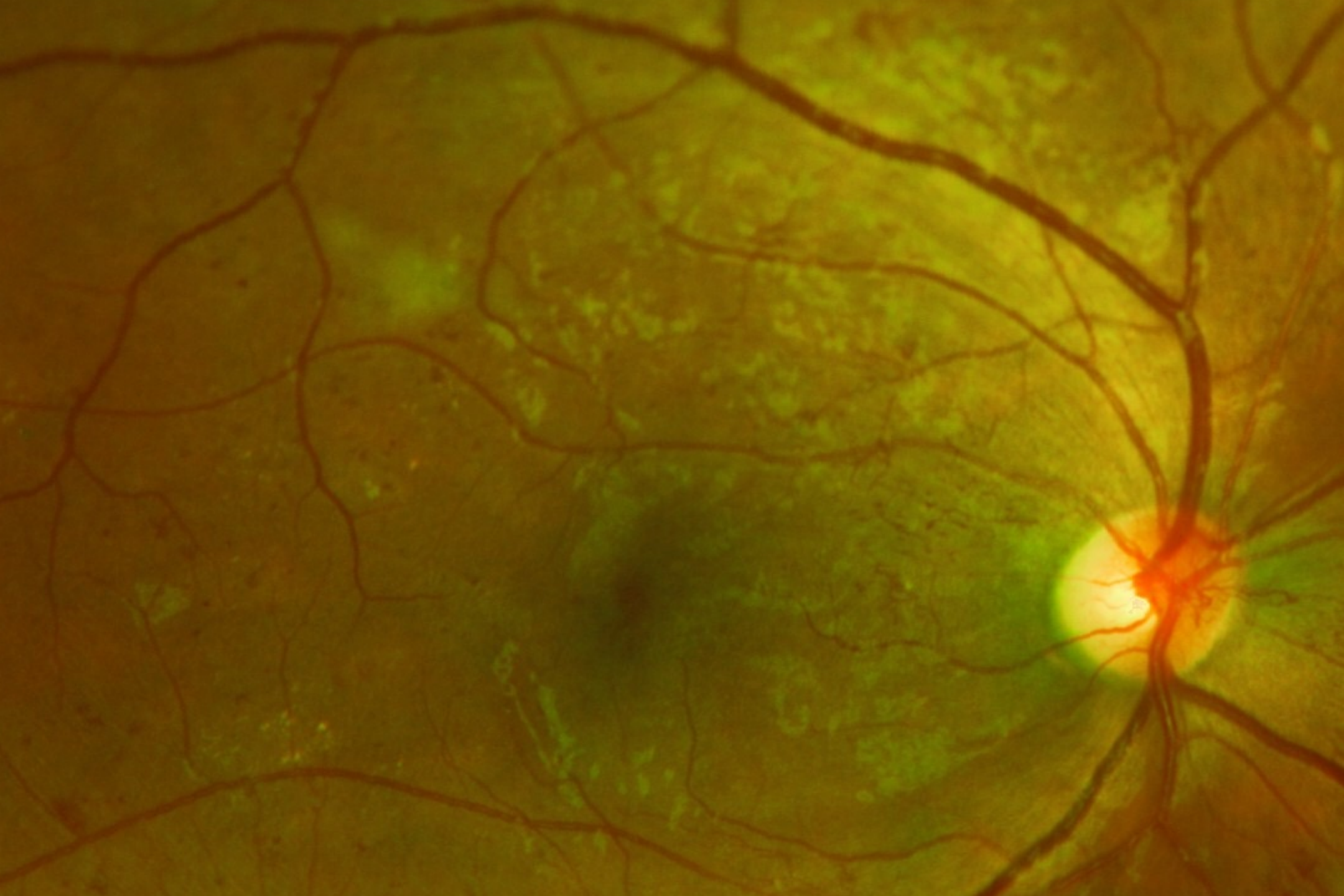


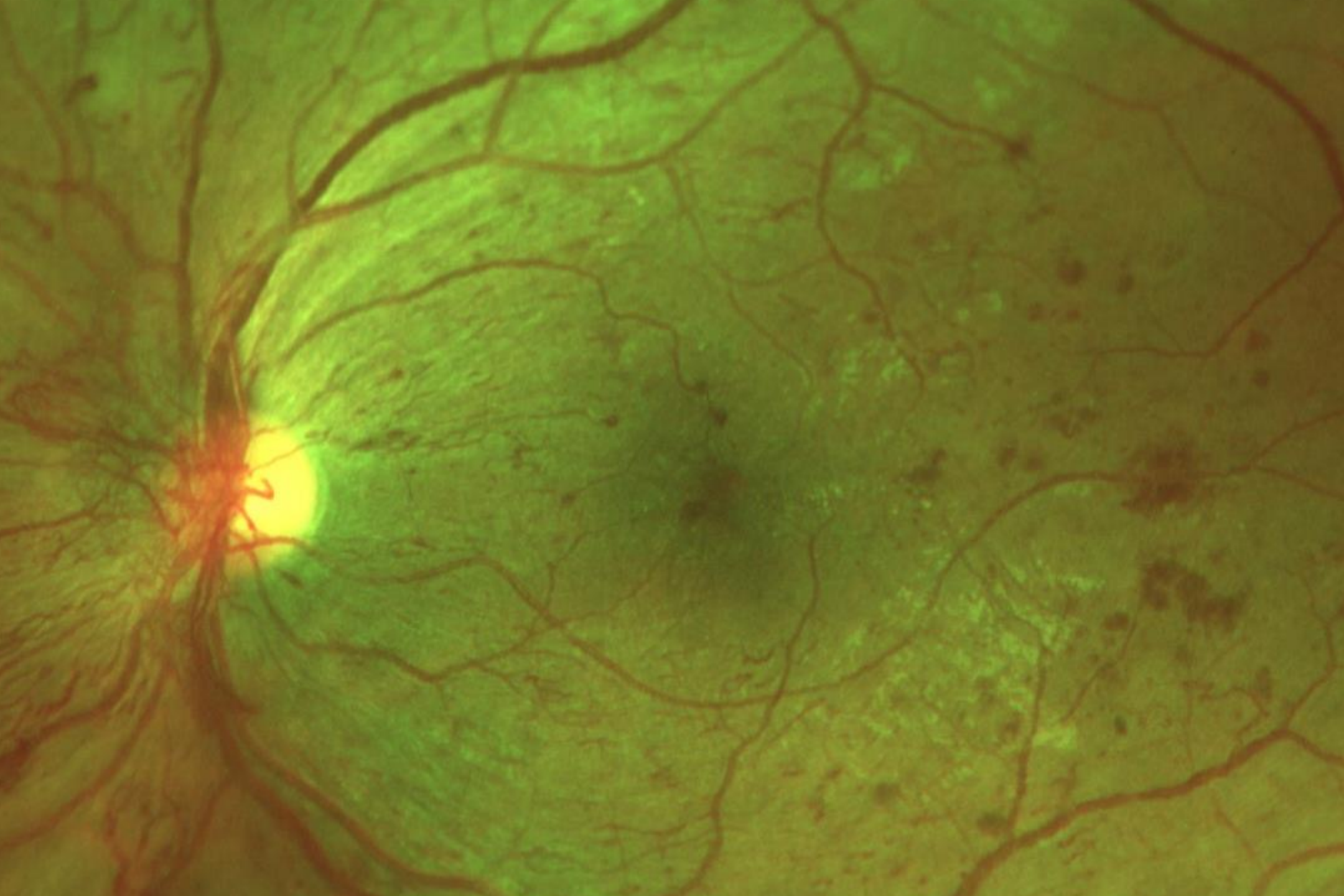
INJECTION TREATMENT

SURGICAL TREATMENT



22 YEAR OLD MALE
White Mountain Apache Tribe





IHS-JVN program

- **Founded by Dr. Mark Horton in collaboration with the Joslin Diabetes Center - Joslin Vision Network (JVN)**
- **All readers are trained and certified at Joslin Diabetes Center**
- **Collaboration - research and development**

Diabetic Retinopathy Surveillance

IHS-JVN Teleretinal Program

98 Physical + 20 Mobile Sites in 25 States

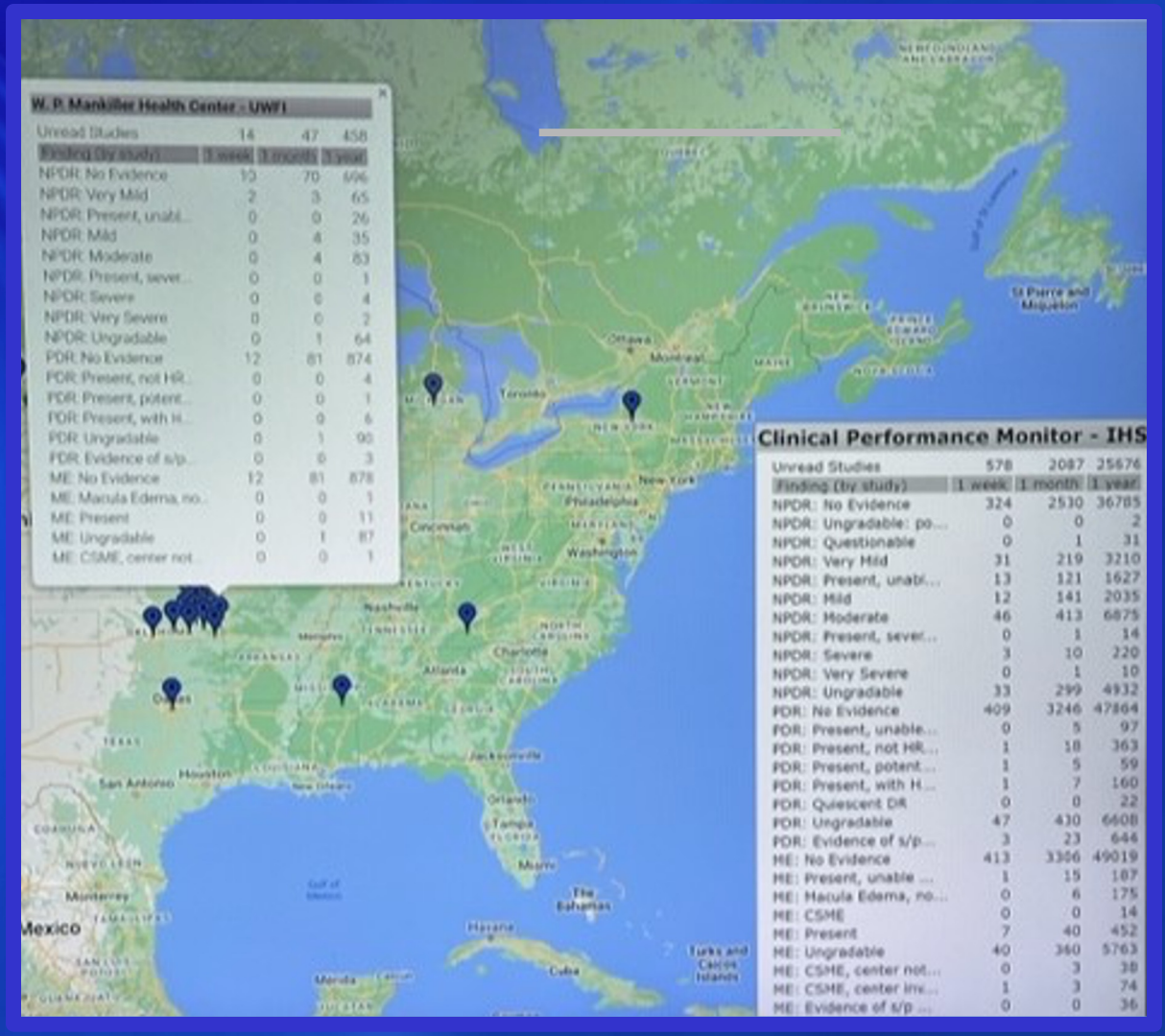
- Phoenix, AZ
- Polacca, AZ
- San Carlos, AZ
- Peach Springs, AZ
- Whiteriver, AZ
- Sells, AZ
- Tuba City, AZ
- Tucson, AZ
- San Xavier, AZ
- Kayenta, AZ
- Chinle, AZ
- Flagstaff, AZ
- Inscription Hse, AZ
- Sacaton, AZ
- Page, AZ
- Cherokee, NC
- Towaoc, CO
- Elko, NV
- Schurz, NV
- Owyhee, NV
- Fallon, NV
- Washakie, WY
- Three Rivers, OK
- A-Mo, OK
- Tama, IA
- Dallas, TX
- Tsaile, AZ
- Carnegie, OK
- Claremore, OK
- Eufaula, OK
- Okmulgee, OK
- Oklahoma City, OK
- Tahlequah, OK
- Lawrence, KS
- Chicago, IL
- Warm Springs, OR
- Cow Creek, OR
- Nespelem, WA
- Yakama, WA
- Wellpinit, WA
- Tacoma, WA
- Fort Hall, ID
- New Town, ND
- Ft. Yates, ND
- Rosebud, SD
- Pine Ridge, SD
- Ft. Peck, SD
- Four Corners, AZ
- Supalpa, OK
- Redbird, OK
- Browning, MT
- Lame Deer, MT
- Crow Agency, MT
- Keweenaw Bay, MI
- Red Lake, MN
- Minneapolis, MN
- Ogema, MN
- Cass Lake, MN
- Laguna, NM
- Shiprock, NM
- Santa Fe, NM
- Albuquerque, NM
- Mescalero, NM
- Crown Point, NM
- Jicarilla, NM
- Gallup, NM
- Winnebago, NE
- Hayward, WI
- Bayfield, WI
- Oneida, NY
- Denver, CO
- Ketchikan, AK
- Aleutian, AK
- Rock Hill, SC
- Oakville, WA
- Blanding, UT
- U&O, UT
- San Diego, CA
- Wagner, SD
- 38 additional sites (not listed)

Planned Deployments

- Komatke, AZ
- SouthCentral (2 mobile cameras, 13 clinics)
- Rosebud, SD
- Fort Defiance, AZ
- Moapa, NV
- Taos, NM
- Chugachmiut, AK

Interactive Site Map

Interactive Site Map



IHS/JVN: A Primary Care Tool

- Imaging stations in PC clinics
- All DM patients w/o a retinal exam in the past 12 months are imaged

JVN Work Station

JVN PROVIDES

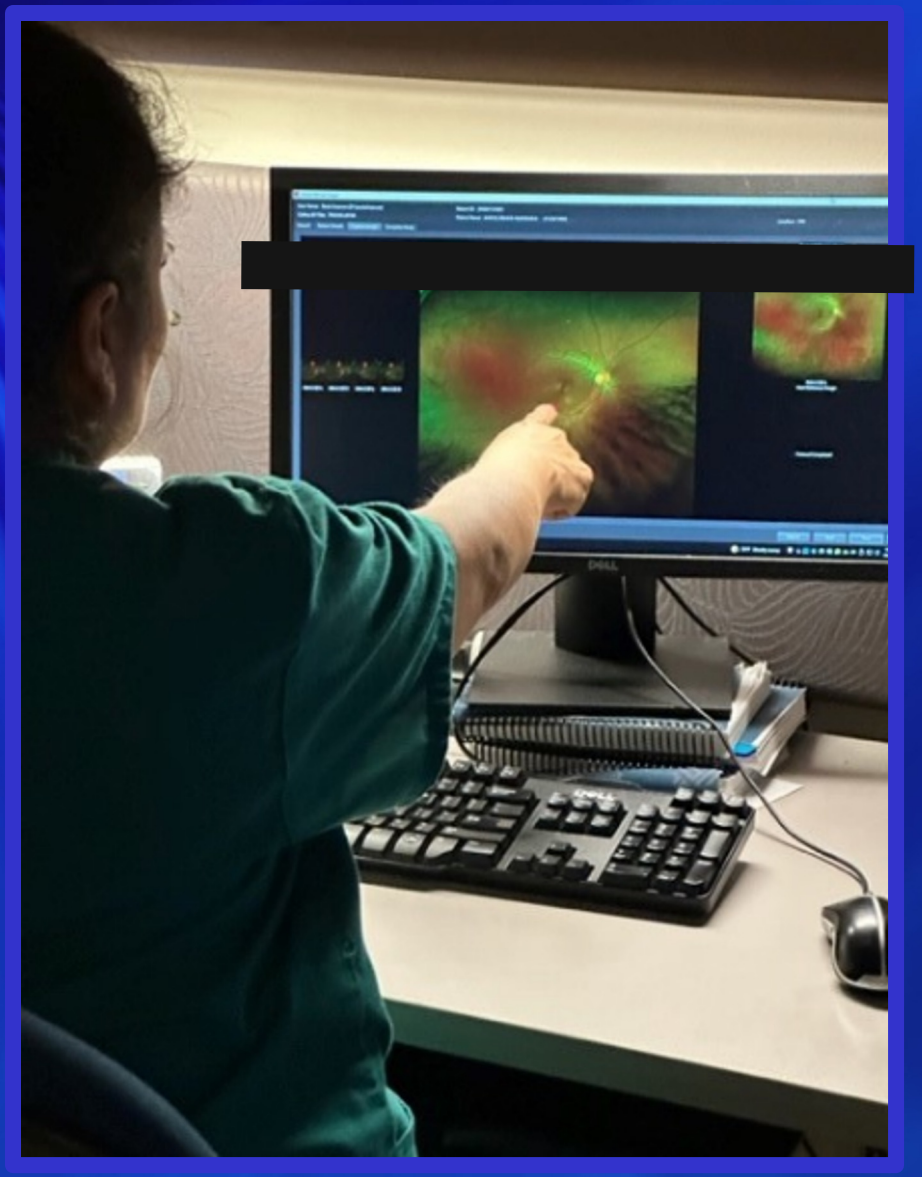
- Camera
- Tablet
- Table
- Computer
- Monitor
- Keyboard
- Mouse

SITE PROVIDES

- Space
- Work Desk
- Desk Phone
- Connectivity

JVN Image Acquisition

- Standardized Training for initial certification
- Imagers identify risk features of moderate and severe retinopathy
- May request immediate reads



Patient Education

Occurs in real time using the patient's images

IHS-JVN Imaging Systems

Non-mydriatic and validated vs retinal exams and ETDRS photos

90% OPTOS (UWF)

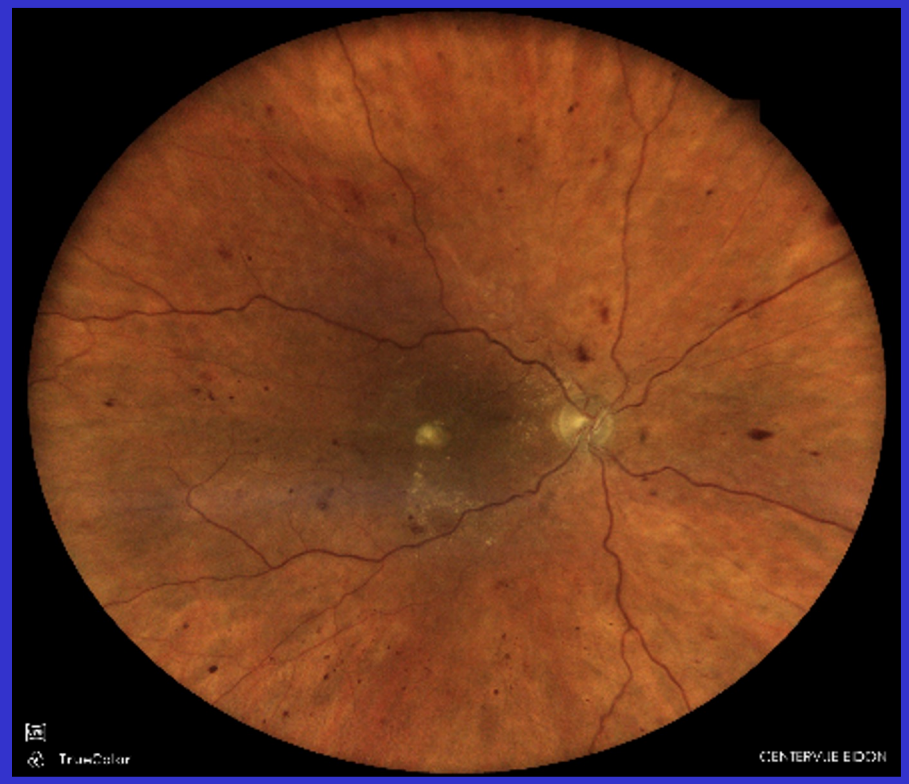
EIDON (mobile sites)

Comparison - Fields of View

OPTOS DAYTONA

200 degrees (2 images each eye)

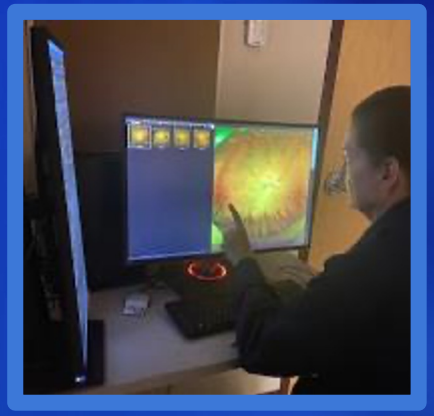
iCARE EIDON

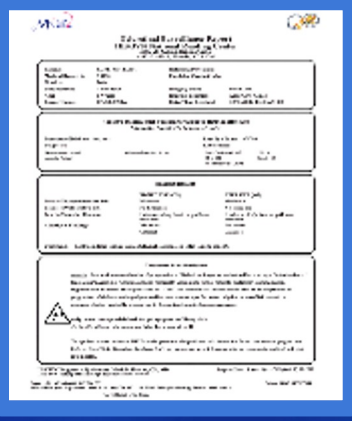


70 degrees - mobile sites (8 images each eye)

Workflow

Image Acquisition Site	National Reading Center	Referring Clinic	Patient
Sites located in primary care clinics	Images read within 48 hours	Report and plan sent to referring clinic	Patients informed Follow-up Appointment Scheduled





IHS-JVN Recommendations

Reading Center

Primary care referrals

⇩

JVN retinal images taken

⇩

Level of retinopathy diagnosed

⇩

Treatment Plan, Follow-up and Referrals Recommended

75% continue with IHS-JVN*

Specific time frame recommended (typically 1 year)

25% referred*

To Optometry or Ophthalmology

*Percentages averaged over time period 2016-2023

Teleretinal Surveillance Report
IHS/JVN National Reading Center

IHS/JVN National Reading Center
4212 N. 16th Street, Phoenix, AZ 85016

Patient:	Demo 1 Demo	**Referring Provider**	Demo, Dr.
Medical Record#:	1000000000000	**Provider Contact Info:**	
Gender:	Female		
Date of Birth:	10/01/1920	**Imaging Date:**	10/13/2023
Age:	103 years	**Imaging Location:**	Phoenix Indian Medical Center
Imager Name:	Giles, Erin	**Date, Time Received:**	10/13/2023 09:26 AM

Patient's Medical Risk Factors for Diabetic Retinopathy (DR)
Information Provided by Referring Practice

Duration of Diabetes	11 Years	**Last Eye Exam:**	
		Lab Studies:	
		A1C: 9%	

Image Results

	RIGHT EYE (OD)	LEFT EYE (OS)
Level of Nonproliferative DR:	Moderate	Moderate
Level of Proliferative DR:	No Evidence	No Evidence
Level of Macular Edema:	No Evidence	No Evidence
Additional Findings:	Cotton wool spots	Cotton wool spots

Comments:

Moderate Nonproliferative Diabetic Retinopathy noted in both eyes. Mild vessel tortuosity and A/V crossing changes noted in both eyes suggestive of hypertension.

*** Treatment Plan Guidance**

HbA1C>= 7.0% < 10.0%, Hypertension, Dyslipidemia:

Elevated HbA1C(>=7%) blood pressure (>=130/80) and lipids have been shown to increase risk of development and progression of diabetic retinopathy, and presence and severity of hard exudates, respectively. Reducing HbA1C>= 7.0% or as low as a medically appropriate to this patient's particular circumstances is recommended as is optimization of lipids and hypertension, also as medically appropriate to this patient's particular circumstances.

Diabetic Retinopathy evident by JVN examination; please see Imaging Results.

Refer to Eye Clinic Based on the above findings, we recommend follow up with an optometrist/ophthalmologist for dilated retinal examination within one month.

IHS/JVN Program Adjudicator: Dara L. Shahon, MD
IHS/JVN Reader: Erin Giles, OD

Report Date, Time: 10/13/2023 10:32 am

Return times and Referrals

DR Level	Plan
No DR	Re-image - 12 months
Mild NPDR	Re-image - 9 months
Moderate NPDR, ci-DME	Refer for retinal exam and/or re-image
Severe NPDR	Refer to general eye or retina
PDR with or without VH, NVD	Refer immediately to Retina

Diabetic Retinopathy - Clinical Management

Primary Care imaging - increases access to care

Ophthalmologist / Optometrist / Primary care team

↓

Timely diagnosis of Retinopathy

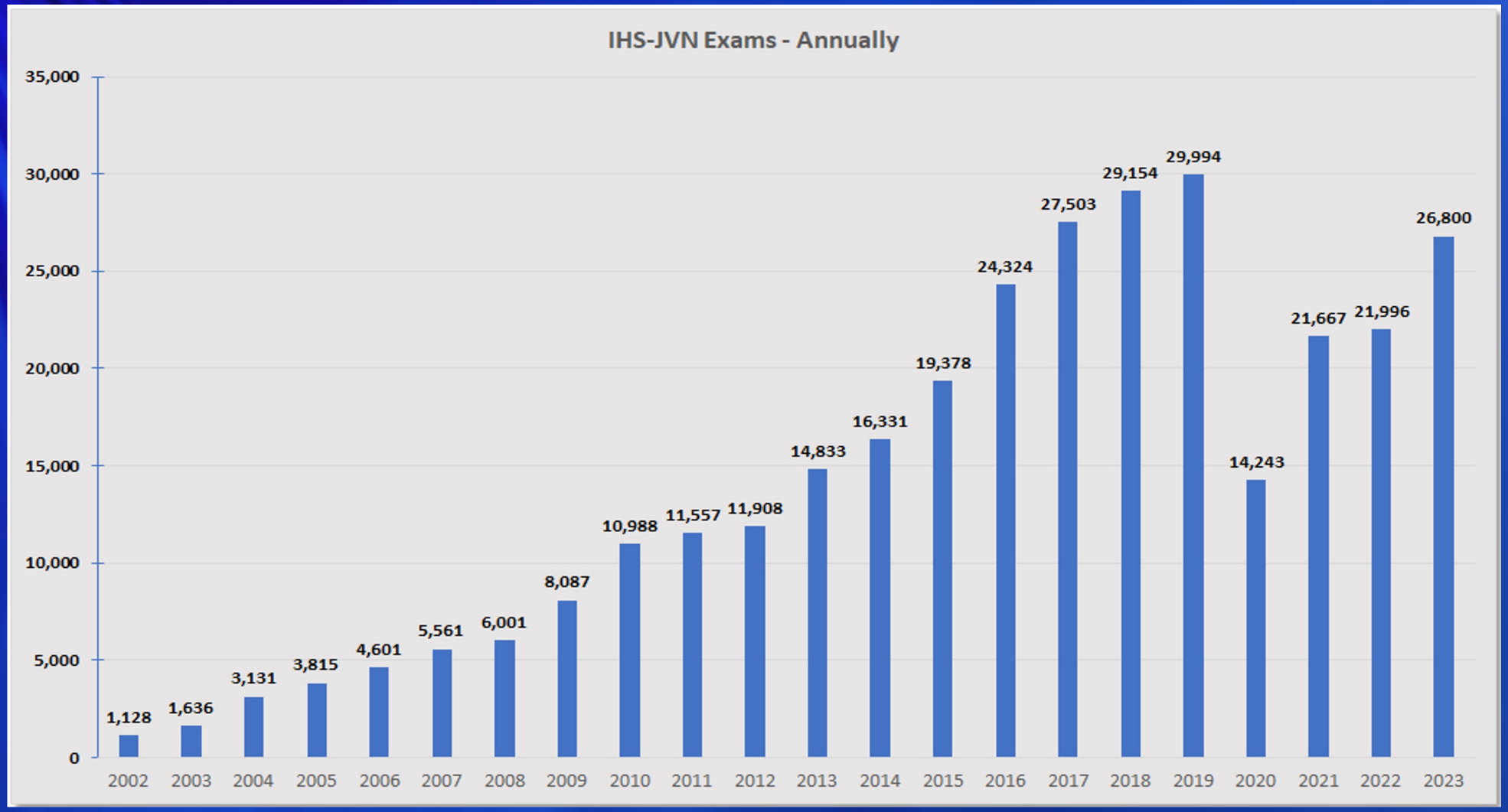
Early treatment

Systemic control of DM-HTN-lipids

Why JVN?

- Increase access to care
- Patient satisfaction
  - Quick, easy and no dilation
- Standard of Care for DR screening
- No Cost
- Billable

Annual IHS-JVN Exams



IHS-JVN program instituted remote imager/refresher training during COVID

The Future of Telehealth in the IHS

- The IHS-JVN program is the only national telemedicine program, offering services throughout the U.S., continually expanding
- The agency supports development of telehealth programs in each service area

Artificial Intelligence

A science that makes computers and machines think and act like humans

AI - How do computers learn to “think?”

- A set of complex instructions called an algorithm is created
- The computer is fed information
- The algorithm allows computers to “learn”

AI - How do computers learn to “think?”

- Computers then recognize patterns
- More information is “fed” and more learning occurs
- Pattern recognition is what allows facial recognition and the diagnosis of the level of diabetic retinopathy

AI and Diabetic Retinopathy

In practice, we make decisions based on experience, findings and knowledge

Figure 1: Bayesian network model predicting the 5 year risk of diabetic retinopathy progression. PDR: proliferative diabetic retinopathy, NPDR: nonproliferative diabetic retinopathy, A1c: hemoglobin A1c, BP: blood pressure, DBP: diastolic blood presure; Max: maximum; Min :minimum; SBP: systolic blood pressure

AI algorithms have already been developed and shown to predict DR progression

IHS-JVN Goals

- 2024 – Presence or absence of DR (as determined by AI) to be validated for our patient population and UWF imaging systems.
- Incorporate prediction of 3 to 5 year progression risk.
- Treatment plan automation
- Self-imaging (Joslin Diabetes Center validated a system)

Current IHS-JVN Research

Adherence study - to examine rates of follow-up for patients with vision threatening retinopathy

IHS/JVN STAFF

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