



Population Health Approach to Glaucoma and Eye Disease Screening

Paula Anne Newman-Casey, MD, MS

University of Michigan

NASEM Meeting

October 30, 2024

Financial Disclosure

- I have the following financial interests or relationships to disclose:
 - Centers For Disease Control and Prevention: Grant Support
 - National Eye Institute: Grant Support
 - National Institute of Biomedical Imaging and Bioengineering: Grant Support
 - Research to Prevent Blindness: Grant Support



U01 DP006442-01



Supported By
Research to Prevent Blindness
Physician Scientist Award



R01EY031337



R01EB032328

Objectives

1. Understand how population-specific disease prevalence affects the false discovery rate in screening
2. How to identify populations at high risk for glaucoma
3. Successful ways to engage high-risk populations in glaucoma screening and improve vision/vision related quality of life

Projected Prevalence of Glaucoma in the US in 2050

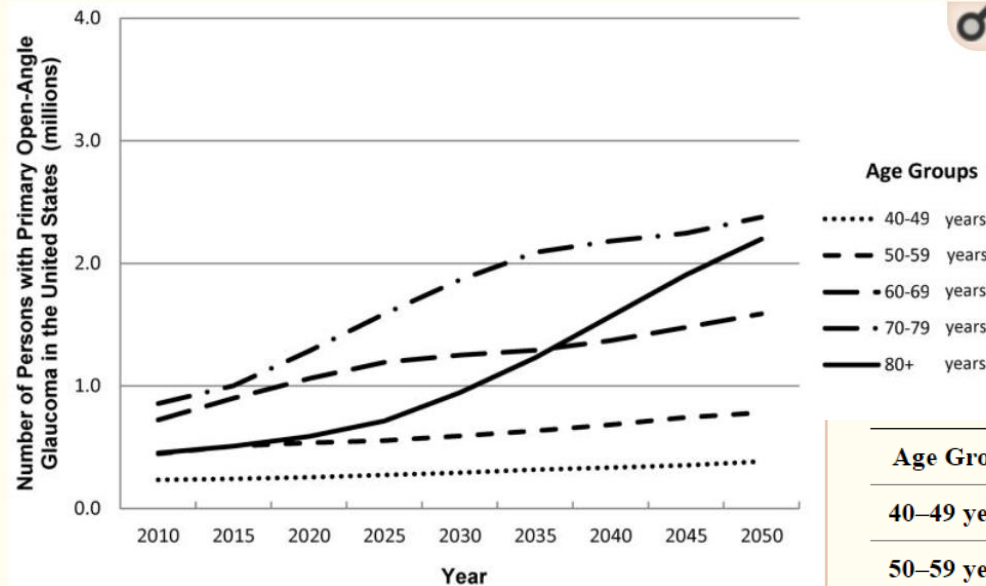


Figure 1

Estimated number of primary open-angle glaucoma cases in the US by age group (all persons)

Age Group	2011	2015	2020	2025	2030	2035	2040	2045	2050
40–49 years	0.23	0.24	0.25	0.27	0.29	0.32	0.33	0.35	0.38
50–59 years	0.45	0.51	0.53	0.55	0.59	0.63	0.68	0.74	0.78
60–69 years	0.72	0.90	1.06	1.19	1.25	1.29	1.37	1.48	1.59
70–79 years	0.85	1.00	1.28	1.59	1.86	2.09	2.18	2.24	2.38
80+ years	0.45	0.51	0.59	0.71	0.95	1.23	1.57	1.91	2.20
Total	2.71	3.15	3.72	4.32	4.94	5.56	6.13	6.72	7.32
Women/Men	1.11	1.10	1.09	1.08	1.08	1.07	1.05	1.02	1.01

Thasarat S. Vajaranant, Shuang Wu, Mina Torres, and Rohit Varma. The Changing Face of Primary Open-Angle Glaucoma in the United States: Demographic and Geographic Changes from 2011–2050 *Am J Ophthalmol.* 2012 Aug; 154(2): 303–314.e3.

Glaucoma Disparities

- People who identify as Black are three times more likely to have glaucoma compared to people who identify as White.
- People who identify as Black are five times more likely to have unilateral blindness from glaucoma compared to people who identify as White.
- People who identify as Black are twice as likely to have bilateral blindness from glaucoma compared to people who identify as White.

Friedman DS. Prevalence of Open-Angle Glaucoma among Adults in the United States. *Arch Ophthalmol* 2004;**122**:532–8.

Sommer A, Tielsch JM, Katz J, *et al*. Racial differences in the cause-specific prevalence of blindness in east Baltimore. *N Engl J Med* 1991;**325**:1412–7.

Tielsch JM, Sommer A, Katz J, *et al*. Socioeconomic Status and Visual Impairment Among Urban Americans. *Arch Ophthalmol* 1991;**109**:637–41.

Glaucoma Disparities

The Relationship Between Components of Metabolic Syndrome and Open-Angle Glaucoma

Paula Anne Newman-Casey, MD,¹ Nidhi Talwar, MS,¹ Bin Nan, PhD,² David C. Musch, PhD,
Joshua D. Stein, MD, MS¹

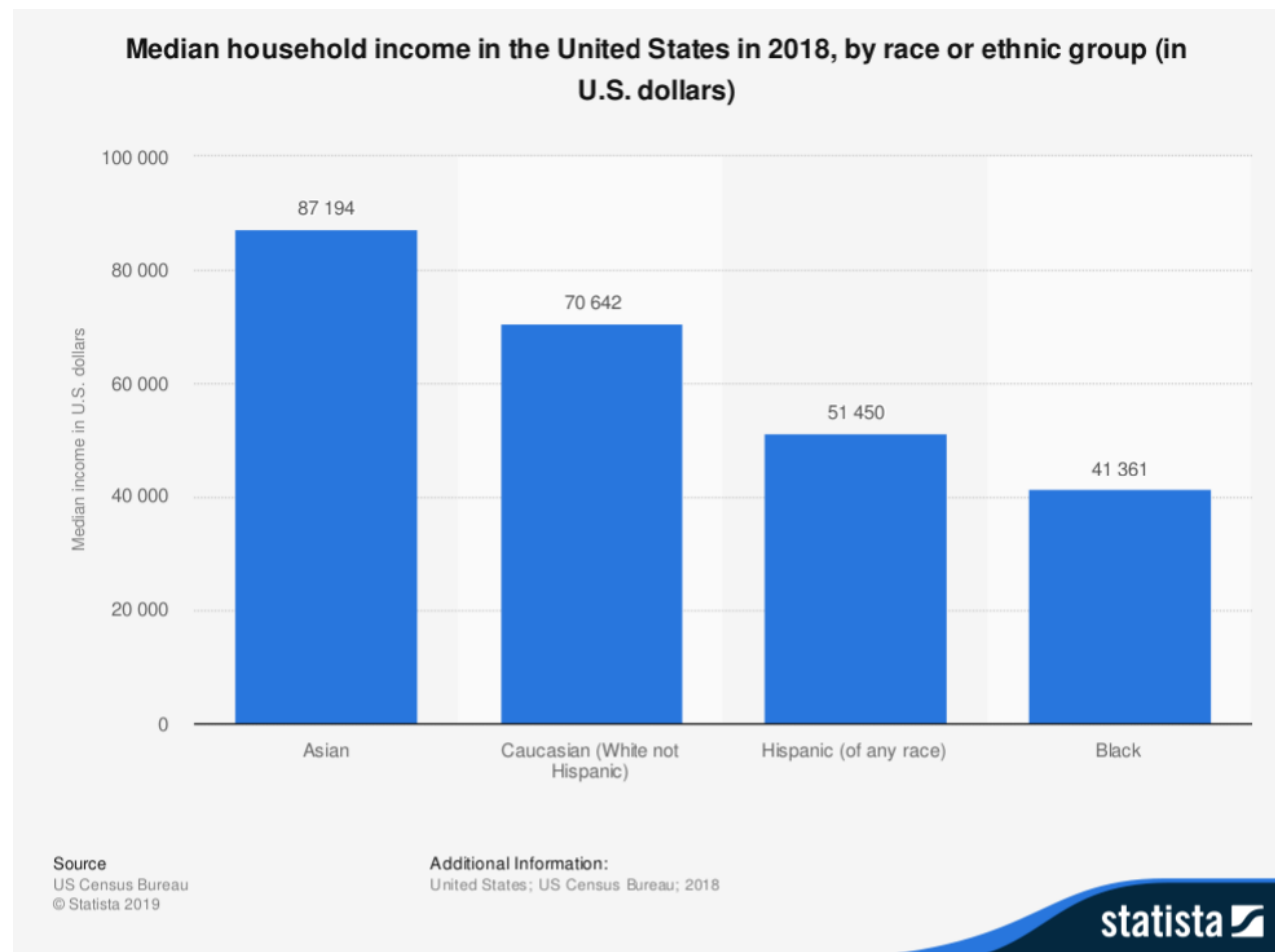
Those with a household net worth of $\geq \$100,000$ had a 12% reduced odds of developing glaucoma compared to people with a household net worth of $\leq \$25,000$ after adjusting for age, sex, race, education, region of residence and medical and ocular co-morbidities

Table 6. Hazard for Open-Angle Glaucoma, according to Race, Education Level, and Household Net Worth

Variable	Patients, n	Adjusted Hazard Ratio (95% CI)*
Race/ethnicity		
White	1485 866	1.00 (Referent)
Black	73 084	2.19 (2.11–2.27)
Latino	96 293	1.38 (1.33–1.44)
Asian American	42 650	1.51 (1.42–1.60)
Other	15 488	1.24 (1.12–1.37)
Net worth		
$\leq \$25\ 000$	130 220	1.00 (Referent)
\$25 000 to \$49 000	55 286	0.97 (0.92–1.04)
\$50 000 to \$74 000	53 226	0.94 (0.88–1.00)
\$75 000 to \$99 000	71 496	0.91 (0.86–0.97)
\$100 000 to \$124 000	144 433	0.88 (0.84–0.92)
\$125 000 to \$249 000	285 307	0.85 (0.82–0.89)
\$250 000 to \$499 000	523 825	0.82 (0.79–0.85)
\$500 000 to \$749 000	247 628	0.78 (0.75–0.82)
\$750 000 to \$999 000	96 307	0.80 (0.76–0.85)
$\geq \$1\ 000\ 000$	139 963	0.81 (0.77–0.86)
Education		
No high school diploma	23 589	1.00 (Referent)
High school diploma	605 810	0.85 (0.79–0.91)
Some college	699 410	0.83 (0.78–0.89)
College diploma	485 790	0.82 (0.76–0.88)
Advanced degree	5083	0.68 (0.54–0.85)

*Multivariable analysis adjusted for each metabolic syndrome component, age, sex, race, education level, household net worth, region of residence at the time of enrollment in the plan, cataract, pseudophakia/aphakia, macular degeneration, diabetic retinopathy, systemic hypotension, sleep apnea, migraine headache, and Charlson comorbidity index.
CI = confidence interval.

Income Disparities



USPSTF Glaucoma Screening Recommendation

Summary of Recommendation

Asymptomatic adults 40 years or older	The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for primary open-angle glaucoma in adults.	I
--	--	---

USPSTF indicates US Preventive Services Task Force.

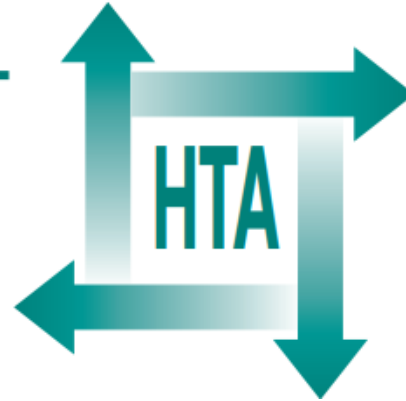
Patient Population Under Consideration

This recommendation applies to adults 40 years or older who present in primary care settings and do not have signs or symptoms of open-angle glaucoma.

Executive summary

Health Technology Assessment 2007; Vol. 11: No. 41

**Health Technology Assessment
NHS R&D HTA Programme
www.hta.ac.uk**



The clinical effectiveness and cost-effectiveness of screening for open angle glaucoma: a systematic review and economic evaluation

JM Burr,^{1*} G Mowatt,¹ R Hernández,²
MAR Siddiqui,¹ J Cook,¹ T Lourenco,¹ C Ramsay,¹
L Vale,^{1,2} C Fraser,¹ A Azuara-Blanco,³ J Deeks,⁴
J Cairns,⁵ R Wormald,⁶ S McPherson,⁷
K Rabindranath¹ and A Grant¹

How does targeting a high-risk population impact false discovery rates?

- Assuming complete eye exam with measurement of intraocular pressure, central corneal thickness, and visual field has 73% sensitivity and 96% specificity for identifying glaucoma:

Glaucoma Prevalence	Positive Predictive Value	False Discovery Rate
0.9% (UK prevalence age>50)	14%	86%
1.4% (US prevalence age >18)	21%	79%
4% (top decile PRS score over 50)	43%	57%
12% (African Americans over age 80)	71%	29%
25% (SIGHT studies rate)	86%	14%

Identifying populations at high risk of glaucoma

What is an FQHC?

- Federally Qualified Health Centers (FQHCs) are primary-care based community clinics that provide medical care in underserved areas regardless of insurance type or insurance status
- FQHCs receive federal support under Public Health Act Section 330, in terms of grants and a flat fee payment structure for services rendered to patients with Medicaid or Medicare
- In 2021, there were 1,373 FQHC hubs with 14,276 clinics in the US.

Demographic Characteristics of FQHCs

Table 1. Characteristics of Federally Qualified Health Centers (FQHCs) overall and stratified by vision care services in 2021.

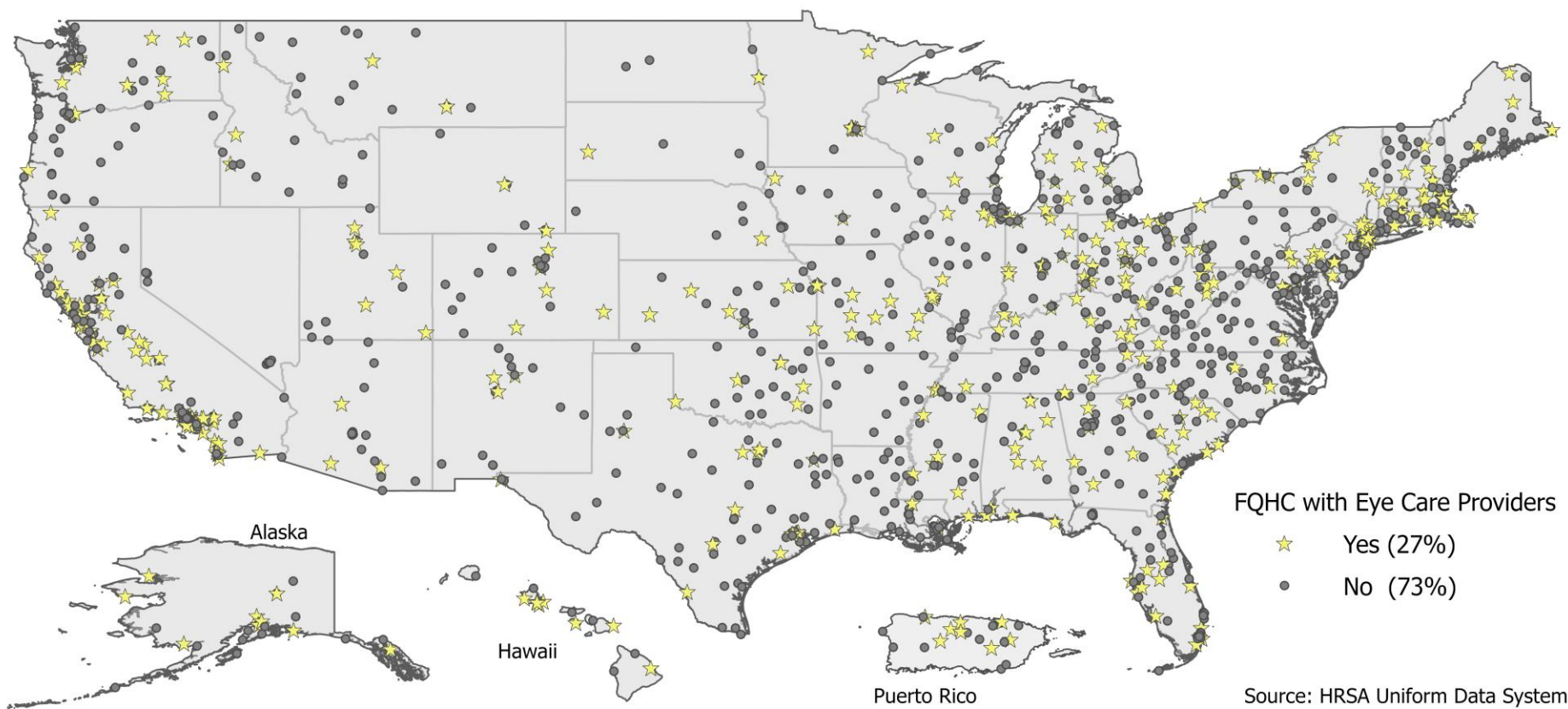
FQHC-level Patient Characteristics	Overall (n=1362) Mean (SD)	Vision Care (n=435, 32%) Mean (SD)	No Vision Care (n=927, 68%) Mean (SD)	P-value
Sex				
Female	56.3 (6.1)	56.4 (6.3)	56.1 (5.9)	0.6195
Male	43.7 (6.1)	43.6 (6.3)	43.9 (5.9)	0.6195
Age				
Children (< 18)	24.7 (11.8)	24.2 (12.0)	25.8 (11.1)	0.0017
Adult (18-64)	63.3 (11.3)	63.5 (11.6)	63.1 (10.8)	0.3303
Older Adults (65+)	12.2 (6.7)	12.5 (7.0)	11.4 (6.2)	0.0191
Race				
White	66.9 (28.4)	68.6 (27.7)	63.3 (29.7)	0.0024
Black/African American	23.3 (25.9)	23.1 (25.8)	23.7 (26.3)	0.8115
Asian	4.3 (10.5)	3.6 (8.8)	5.6 (13.3)	0.0001
American Indian/Alaska Native	3.3 (10.8)	3.0 (9.3)	4.0 (13.3)	0.0704
Native Hawaiian / Other Pacific Islander	1.2 (4.8)	0.9 (2.8)	1.8 (6.9)	0.0377
More than one race	3.7 (7.4)	3.4 (6.5)	4.3 (9.0)	0.2929
Hispanic/Latino Ethnicity	29.3 (27.9)	27.2 (26.6)	33.9 (29.9)	0.0007
Insurance				
Medicaid/CHIP	44.0 (17.9)	42.8 (18.0)	46.8 (17.5)	<0.0001
→ Medicare	12.0 (7.4)	12.4 (7.6)	11.0 (6.8)	0.0032
Other Third Party	22.1 (12.7)	23.2 (12.7)	19.8 (12.3)	<0.0001
→ Uninsured	22.1 (16.9)	21.8 (16.1)	22.9 (18.4)	0.7067
→ Patients at or below 100% of FPL	62.9 (19.1)	61.3 (19.3)	66.3 (18.2)	<.0001
→ Non-English Speaker	20.7 (22.3)	18.4 (20.9)	25.4 (24.3)	<.0001
Diabetes	15.6 (5.5)	15.5 (5.8)	15.7 (4.7)	0.2390
Uncontrolled Diabetes (HbA1c >9%)	5.0 (2.2)	5.0 (2.3)	5.0 (2.1)	0.5297
Hypertension	32.3 (10.2)	32.6 (10.6)	31.4 (9.2)	0.0287

In 2021, 11.6% of Americans lived below the poverty line, 8.3% were uninsured, 18.7% had Medicaid

CHIP, Children's Health Insurance Program. FPL, Federal Poverty Line. FQHC, Federally Qualified Health Center. HbA1c, Hemoglobin A1C. SD, Standard Deviation

Do FQHCs Provide Vision Care?

Federally Qualified Health Centers (FQHCs) in the United States, 2021



Neighborhood Characteristics of FQHCs

Table 2. Neighborhood Characteristics of Federally Qualified Health Centers (FQHCs) funded in 2021 overall and stratified by vision care services.

	Overall (n=1362)	Vision Care (n=435)	No Vision Care (n=927)	
Continuous Variable	Mean (SD)	Mean (SD)		P-value
Income per capita (USD)*	28,982.6 (18,721.1)	28,992.1 (22,134.9)	28,978.7 (17,127.1)	0.0693
National ADI Rank*	66.3 (26.9)	63.4 (30.0)	67.5 (25.4)	0.2126
Neighborhood People of Color (%)*	48.0 (33.2)	52.8 (33.3)	46.0 (32.9)	0.0028
Neighborhood Hispanic/Latino (%)*	17.9 (25.8)	20.9 (27.3)	16.7 (25.1)	0.0221
Neighborhood Medicaid (%)†	30.8 (16.5)	33.7 (17.1)	29.6 (16.1)	0.0003
People with No Insurance (%)†	10.6 (7.8)	10.7 (8.7)	10.6 (7.4)	0.2811
Household with No Car (%)*	19.2 (19.4)	23.1 (21.6)	17.6 (18.2)	0.0003
Average Number of Cars per Household*	1.5 (0.5)	1.4 (0.5)	1.5 (0.5)	0.0118
Gini Index†	0.46 (0.07)	0.462 (0.072)	0.457 (0.072)	0.0519
Families Receiving Food Stamp/SNAP Benefits (%)†	23.3 (17.7)	25.3 (18.2)	22.5 (17.4)	0.0106
Owner Cost Burden (%)*	23.5 (18.3)	25.6 (19.6)	22.7 (17.7)	0.0277
Renter Cost Burden (%)*	45.4 (21.2)	46.0 (20.5)	45.2 (21.5)	0.3884
Categorical Variable	Frequency (%)	Frequency (%)		P-value
Expanded Medicaid	1055 (77.5)	349 (80.2)	706 (76.2)	0.1082
Urban	796 (58.4)	294 (67.6)	502 (54.2)	<0.0001

ADI, Area Deprivation Index. SNAP, Supplemental Nutrition Assistance Program. USD, United State Dollar. SD, Standard Deviation.

*Census block group level. †Census tract level.

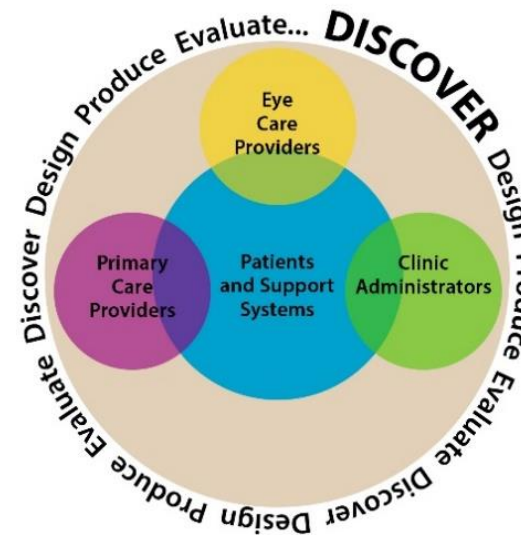
Overall US
population,
18.7% have
Medicaid,
8.3%
uninsured,
8.3% have
no car,
12.5%
receive
food stamps

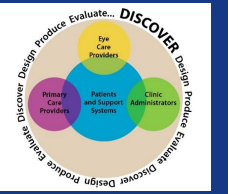
- Leveraging the national network of FQHCs to access people at high risk of eye disease and high risk of underutilization of eye care could represent a national strategy to mitigate eye health disparities in the US
- When polygenic risk scores for glaucoma become affordable, reimbursed by CMS, and easily accessible, further risk stratification for glaucoma screening and monitoring could be possible

Successful ways to engage populations at high risk of eye disease in eye disease screening

Community Engaged Research

2. Conduct interviews key stakeholders to understand and overcome barriers to glaucoma screening program implementation.





1. Create a Community Advisory Board (CAB) to solidify trust and identify ways to sustain the program.



Executive Members of CAB

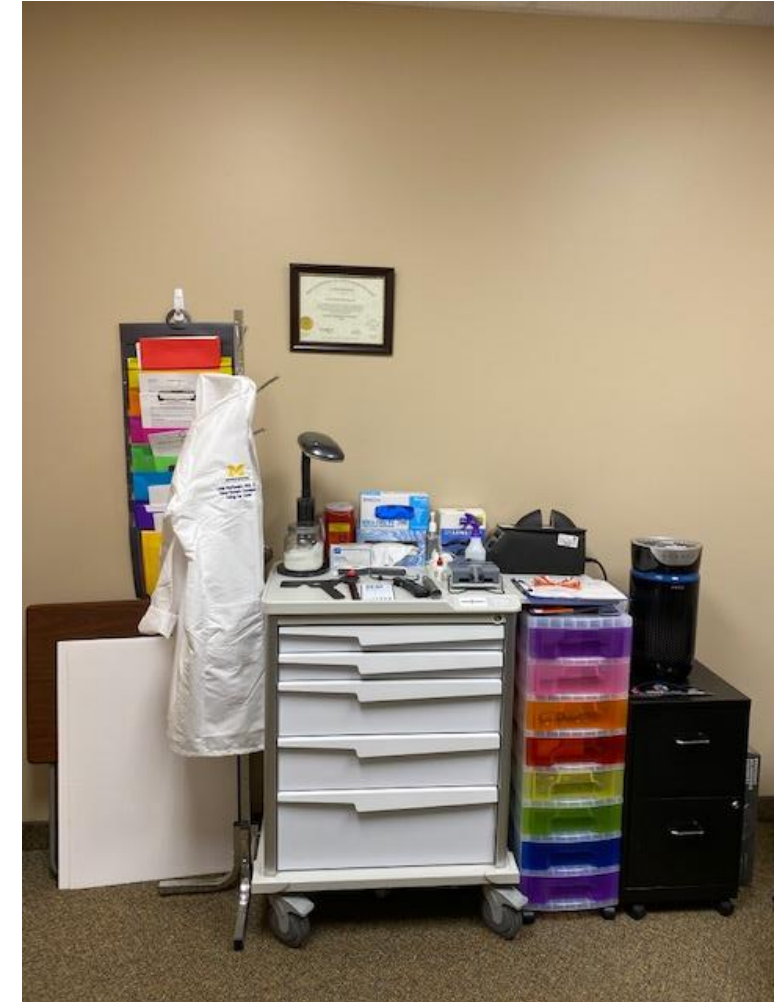
SIGHT

Screening and Intervention for Glaucoma
and eye Health through Telemedicine

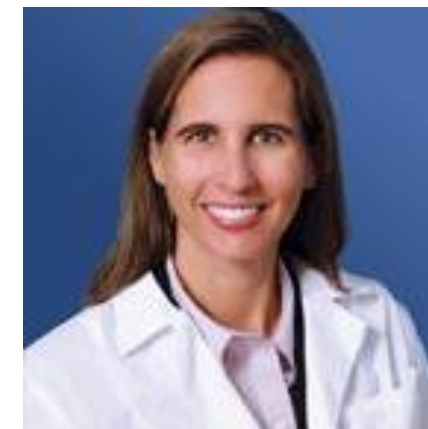
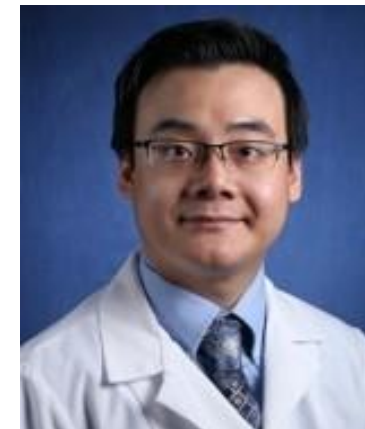
Key Stakeholder Recommendations

- Program should be housed in the community clinic.
- Program should be available
- Community outreach should include flyers and posters at clinics, bus stops, churches, libraries, barber shops and foodbanks and outreach via additional media (social media, television, radio) to let people know about the program.

Michigan Screening and Intervention for Glaucoma and Eye Health through Telemedicine Program (MI-SIGHT)



Ophthalmologists Behind the Curtain



[https://www.pinterest.com/search/pins/?q=the%20man%20behind%20the%20curtain&rs=typed&term_meta\[\]=the%20man%20behind%20the%20curtain%7Ctyped](https://www.pinterest.com/search/pins/?q=the%20man%20behind%20the%20curtain&rs=typed&term_meta[]=the%20man%20behind%20the%20curtain%7Ctyped)

MI SIGHT Cohort Demographics

	Overall (n=3714)		Free Clinic (n=1605)		FQHC (n=2109)		
Continuous Variable	N	Mean (SD), Median	N	Mean (SD), Median	N	Mean (SD), Median	Holm P-value
Age (years)	3714	54.1 (15.9), 56.3	1605	54.5 (15.9), 56.8	2109	53.8 (15.9), 55.9	0.95
Presenting LogMAR VA - Better Eye	3711	0.13 (0.22), 0.00	1604	0.11 (0.23), 0.00	2107	0.14 (0.22), 0.04	<0.0001
Categorical Variable	#/total (%)		#/total (%)		#/total (%)		
Sex - Male	1377/3677 (37.5)		582/1584 (36.7)		795/1298 (38.0)		0.95
Race							
White	1085/3413 (31.8)		586/1487 (39.4)		499/1926 (25.9)		<0.0001 ^a
Black	1775/3413 (52.0)		544/1487 (36.6)		1231/1926 (63.9)		
Asian	187/3413 (5.5)		175/1487 (11.8)		12/1926 (0.6)		
Other/Multiracial	366/3413 (10.7)		182/1487 (12.2)		184/1926 (9.6)		
Ethnicity - Hispanic	608/3197 (19.0)		233/1306 (17.8)		375/1891 (19.8)		0.95

MI SIGHT Cohort SDoH

Education	Overall	Free Clinic	FQHC	
<HS	363/3649 (10.0)	163/1563 (10.4)	200/2086 (9.6)	<0.0001 ^b
HS or Equivalent	1171/3649 (32.1)	405/1563 (25.9)	766/2086 (36.7)	
Some College	1114/3649 (30.5)	430/1563 (27.5)	684/2086 (32.8)	
College Degree	605/3649 (16.6)	334/1563 (21.4)	271/2086 (13.0)	
Graduate/Professional Degree	396/3649 (10.9)	231/1563 (14.8)	165/2086 (7.9)	
Income				
<\$10k	632/2829 (22.3)	307/1198 (25.6)	325/1631 (19.9)	0.0007 ^c
\$10k-\$19,999	595/2829 (21.0)	251/1198 (21.0)	344/1631 (21.1)	
\$20k-\$29,999	570/2829 (20.2)	251/1198 (21.0)	319/1631 (19.6)	
\$30k-\$49,999	562/2829 (19.9)	200/1198 (16.7)	362/1631 (22.2)	
\$50k-\$69,999	240/2829 (8.5)	86/1198 (7.2)	154/1631 (9.4)	
\$70k+	230/2829 (8.1)	103/1198 (8.6)	127/1631 (7.8)	
Unemployed/Retired/Disable/ Homemaker/Student	2134/3659 (58.3)	933/1567 (59.5)	1201/2092 (57.4)	0.95
No Health Insurance	865/3630 (23.8)	628/1549 (40.5)	237/2081 (11.4)	<0.0001
Primary Language not English	747/3693 (20.2)	400/1595 (25.1)	347/2098 (16.5)	<0.0001

MI SIGHT Cohort Medical History

Self-reported Medical History	Overall	Free Clinic	FQHC	Holms adjusted p-value
Diabetes	880/3616 (24.3)	305/1548 (19.7)	575/2068 (27.8)	<0.0001
Hypertension	1636/3598 (45.5)	615/1532 (40.1)	1021/2066 (49.4)	<0.0001
Current Smoker	632/3671 (17.2)	189/1576 (12.0)	443/2095 (21.2)	<0.0001
Self-reported Glaucoma	152/3039 (5.00)	65/1216 (5.4)	87/1823 (4.8)	0.95
Family History Glaucoma	771/3039 (25.4)	293/1216 (24.1)	478/1823 (26.2)	0.95
Last dilated eye exam >2 year/Never	1788/2940 (60.8)	802/1246 (64.4)	986/1694 (58.2)	0.005

MI SIGHT Cohort – Did We Enroll Under-utilizers of Eye Care?

Question	≥65 years (n=284) # (%)	Diabetes (n=433) # (%)	Family History Glaucoma (n=250) # (%)	Self-reported Glaucoma (n=46) # (%)
When was the last time you had your eyes examined by any doctor or eye care provider?				
Within the past month	11 (4.0)	16 (3.8)	11 (4.5)	5 (11.4)
1 month to <1 year	75 (27.6)	148 (35.2)	79 (32.4)	22 (50.0)
1 year to <2 years	35 (12.9)	42 (10.0)	24 (9.8)	3 (6.8)
2 or more years ago	148 (54.4)	201 (47.9)	125 (51.2)	14 (31.8)
Never	3 (1.1)	13 (3.1)	5 (2.1)	0 (0.0)
How long has it been since you last visited an eye doctor to have your eyes dilated?				
This year	53 (23.3)	75 (21.3)	42 (20.7)	18 (43.9)
Within 2 years	52 (22.8)	131 (37.2)	70 (34.5)	14 (34.2)
More than 2 years	114 (50.0)	122 (34.7)	72 (35.5)	9 (22.0)
Never	9 (4.0)	24 (6.8)	19 (9.4)	0 (0.0)

MI SIGHT Cohort Eye Disease Prevalence Compared to US Prevalence

	MI-SIGHT	National Average	
Screening Variable	% (n)	%	P-value*
Visual Impairment (Better Eye <20/40)	11.5% 426/3705	5.3% ^a	<0.0001
Cataract	22.9% (798/3484)	17% ^b	<0.0001
Glaucoma	22.5% (833/3709)	6-9% ^c	<0.0001
Macular Degeneration	1.7% (64/3714)	1.5% ^d	0.26
Diabetic Retinopathy	4.7% (170/3624)	3.4% ^e	<0.0001

^aVitale S, Cotch MF, Sperduto RD. Prevalence of Visual Impairment in the United States. JAMA 2006;295:2158–2163.

^bKlein BE, Klein R, Linton KL. Prevalence of age-related lens opacities in a population. The Beaver Dam Eye Study. Ophthalmology 1992;99:546–552.

^cGupta P, Zhao D, Guallar E, et al. Prevalence of Glaucoma in the United States: The 2005-2008 National Health and Nutrition Examination Survey. Invest Ophthalmol Vis Sci 2016;57:2905–2913.

^dFriedman DS, O'Colmain BJ, Munoz B, et al. Prevalence of age-related macular degeneration in the United States. Arch Ophthalmol 2004;122:564–572.

^eKempner JH, O'Colmain BJ, Leske MC, et al. The prevalence of diabetic retinopathy among adults in the United States. Arch Ophthalmol 2004;122:552–563.

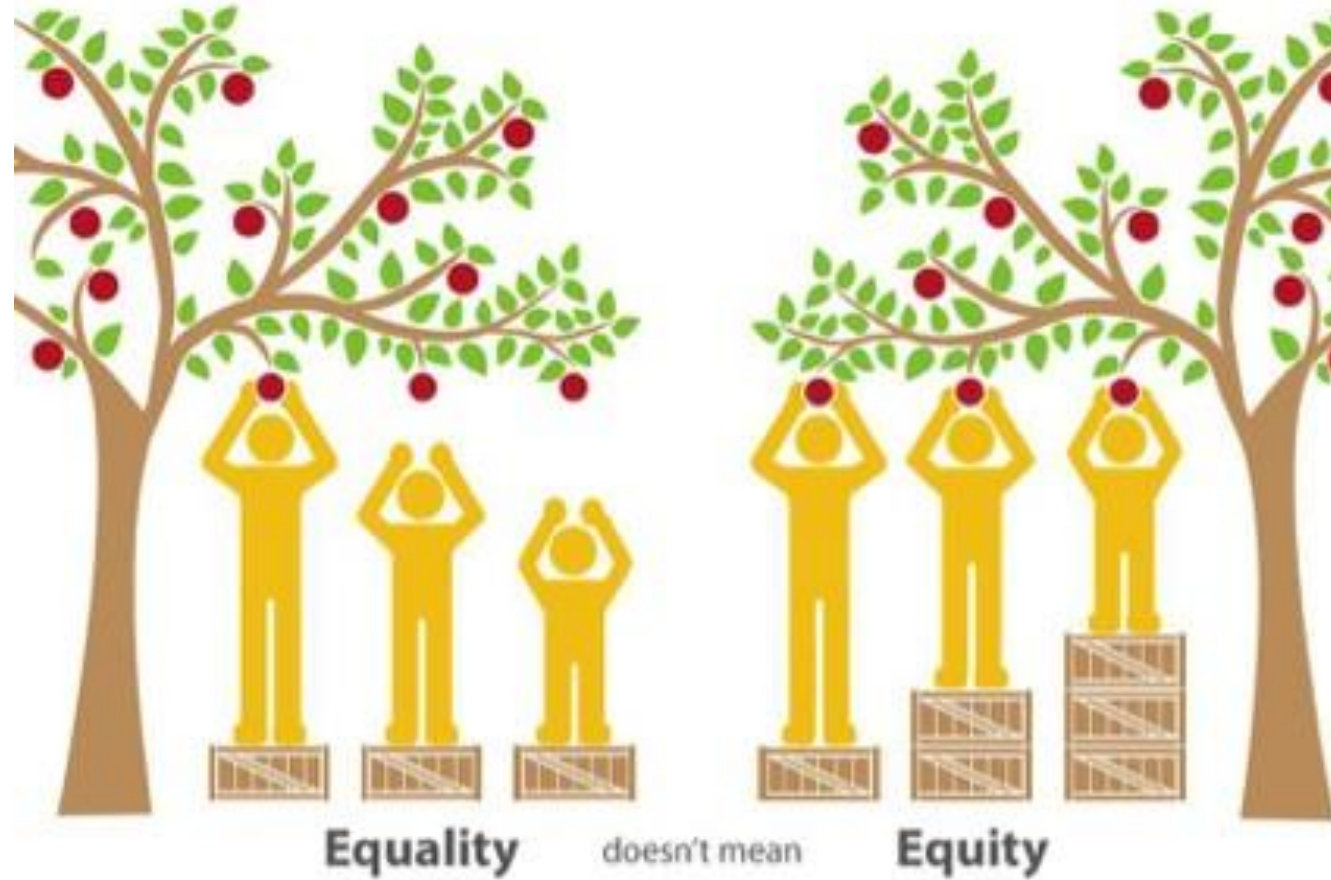
Repeat Screening Outcomes

	Baseline		Follow-up		Holm
Variable	n	mean (SD), median	n	mean (SD), median	P-value*
Overall (n=766 VA, 938 VFQ)					
Presenting logMAR VA - Worse Eye**	763	0.25 (0.59), 0.10	763	0.21 (0.52), 0.06	0.0012
Composite	937	81.1 (14.1), 83.9	937	86.4 (12.0), 89.4	<0.0001
General Vision	930	70.8 (17.3); 80.0	930	74.9 (16.5), 80.0	<0.0001
Near Activities	933	81.0 (18.3), 83.3	933	88.6 (15.4), 91.7	<0.0001
Distance Activities	905	86.7 (20.3), 100.0	906	91.5 (17.7), 100.0	<0.0001
Mental Health	928	60.6 (29.1), 50.0	928	64.9 (30.4), 75.0	0.0001
Role Difficulties	920	88.8 (24.7), 100.0	920	93.2 (20.3), 100.0	<0.0001
Driving	844	92.5 (16.4), 100.0	844	95.6 (13.5), 100.0	<0.0001
Peripheral Vision	919	90.1 (17.6), 100.0	91	93.5 (14.8), 100.0	<0.0001

Policy Changes Needed to Expand Glaucoma Screening and Care in Low Income Communities

- Medicaid reimburses less than Medicare and commercial insurance making it difficult for ophthalmologists to sustain a practice serving a large percentage of people insured by Medicaid
- Optometrists and ophthalmologists are not eligible for the National Health Service Corps Loan Repayment Program that incentivizes primary care, mental health care, and ob/gyns to practice in medically underserved areas by repaying school loans
- Federally Qualified Health Centers receive a flat per-patient, per-visit fee, which does not account for ancillary testing costs, making it difficult for FQHCs to purchase expensive equipment such as OCTs, fundus cameras, autorefractors, iCares, pachymeters etc.
- Telemedicine is reimbursed by Medicare only for diabetic retinopathy screening and is reimbursed at very low rates: using AI can bill \$45.36, otherwise it is \$29.48 for those with diabetes and retinopathy and \$16.94 for those with diabetes without retinopathy, making telemedicine financially infeasible for diseases other than DR

Equity Requires Resources



Thank you



Clarence Pierce
CEO



Leroy Johnson, MD
Ophthalmologist



Sherry Pace, MBA
COO



Michael Giacalone,
Jr., MD, CMO



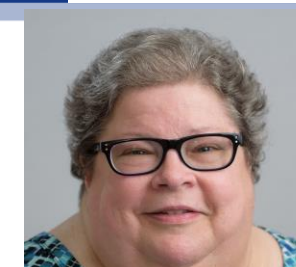
Stacy Sawyer
Communications
& Marketing



Martha Kershaw, MD,
Medical Director



Iris Proctor
Director of Integrated Services



Julie Brown, RN
Patient Support
Services Coordinator



Ann Marie Peterson
Director



Paula Anne
Newman-Casey,
MD, MS, PI



Ken Resnicow, PhD



Michele Heisler,
MD, MPA



Paul P. Lee,
MD, JD



Deborah Darnley-
Fisch, MD



David Musch,
PhD, MPH,
Epidemiologist



Jason Zhang, MD
Glaucoma



Angela Elam,
MD, Glaucoma



Sayoko Moroi,
MD, PhD,
Consultant



Emily Webber, BS
Study Coordinator



Maria Woodward,
MD, MS



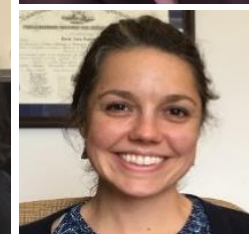
Jade Livingston, BS
Study Coordinator



Leslie Nizio,
MS
Biostatistician



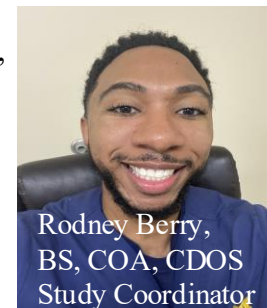
Londa Reid-Sanders, BS, COA,
Study Coordinator



Chamisa MacKenzie
MSW, MPH,
MI Trainer



Phalatha
McHaney-Conner
Study Coordinator



Rodney Berry,
BS, COA, CDOS
Study Coordinator



Suzanne Winter, MS
Project Manager