

Autonomous artificial intelligence increases health equity for patients who are more at risk for poor visual outcomes due to diabetic eye disease

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BACKGROUND

- The number of Americans with diabetic retinopathy (DR) is projected to be 16 million by 2050.
- Annual testing for DR is recommended. The standard of care is a diabetic eye exam conducted by an ophthalmologist, usually referred by a primary care provider.
- In 2018, the FDA approved IDx-DR, an autonomous artificial intelligence (AI) system that tests for diabetic retinopathy.

STUDY OBJECTIVE

- To compare the characteristics of patients referred to Wilmer Eye Institute via the standard of care (SOC) and AI pathways.

METHODS

Design	Retrospective analysis
Participants	Patients with diabetes mellitus who were referred to and examined at Wilmer between August 2020 and September 2022
Main Outcomes	Difference between SOC and AI groups for: <ul style="list-style-type: none"> Best corrected visual acuity (BCVA) of the better-seeing eye BCVA of the worse-seeing eye Average of the BCVA of both eyes Days between referral and Wilmer visit date
Data Collection	<ul style="list-style-type: none"> Performed by CCDA See Table 1 for selected variables. Additional variables collected include ethnicity, language, need for an interpreter, microalbuminuria status, Type 2 diabetes, EGFR and HbA1c.
Statistics	<ul style="list-style-type: none"> For Table 1: Mann-Whitney U, Student's T, chi-squared, and Fisher's exact tests For main outcomes: multivariable log-linear (for days between referral and Wilmer visit) and linear regression (for the others). All other variables were included as covariates except EGFR, which had missing data points

RESULTS

Term	Exp. Estimate	Confidence Interval
Sex, Male	0.90	[0.83,0.99]
Race, White (ref. level Black)	1.20	[1.09,1.32]
Insurance, Military (ref. level Pure Medicare)	0.74	[0.65,0.85]
Proliferative Diabetic Retinopathy, Yes	0.62	[0.48,0.81]
SOC or AI Group, AI Group	1.30	[1.13,1.50]
BCVA, better-seeing eye (in units of 0.1 LogMAR)	18.72	[1.97,178.29]

Table 2: Significant predictors from multivariable log-linear regression analysis. The response variable was days between referral and Wilmer visit.

RESULTS (continued)

Variable Name	SOC Subgroup Statistics		AI Subgroup Statistics	P-Value
	Mean (SD), Count (%) or Median [IQR]			
Demographics				
Age	61.9 (14.1)		63.2 (12.5)	0.05
Sex, F	1738 {51.8}		225 {57.3}	0.048
Patient Race				<0.001
Black	1489 {44.4}		255 {64.9}	
Asian	244 {7.3}		7 {1.8}	
White	1205 {35.9}		111 {28.2}	
Other	414 {12.4}		20 {5.1}	
Marital Status, Y	1749 {52.2}		164 {41.7}	
Insurance Coverage for Visit				<0.001
Medicaid	309 {9.7}		28 {7.3}	
Medicare Advantage	286 {9.0}		41 {10.6}	
Military	545 {17.2}		32 {8.3}	
Pure Medicare	982 {30.9}		152 {39.4}	
Commercial and Other	1055 {33.2}		133 {34.5}	
Disease Status				
Proliferative Diabetic Retinopathy, Y	110 {3.3}		11 {2.8}	0.7
Hypertension, Y	2768 {82.6}		352 {89.6}	0.001
Chronic Kidney Disease, Y	699 {20.9}		103 {26.2}	0.02
Type 1 Diabetes, Y	253 {7.5}		25 {6.4}	0.5
Insulin Exposure	1334 {39.8}		166 {42.2}	0.4
Miscellaneous				
Days between referral visit and Wilmer visit	41 [17.0, 85.0]		43 [22.0, 111.0]	0.002
Visual Acuity				
BCVA, better-seeing eye	0 [0.0, 0.1]		0.1 [0.0, 0.1]	0.02
BCVA, worse-seeing eye	0.1 [0.0, 0.3]		0.1 [0.0, 0.3]	0.01
Mean BCVA of both eyes	0.1 [0.0, 0.2]		0.1 [0.0, 0.2]	0.01

Table 1: Selected study population characteristics

Coefficients	BCVA of Better-Seeing Eye			BCVA of Worse-Seeing Eye			Mean of BCVA of Both Eyes		
	Estimate	Confidence Interval	P-Value	Estimate	Confidence Interval	P-Value	Estimate	Confidence Interval	P-Value
Sex, Male	-0.018	[-0.031, -0.005]	0.006	-0.015	[-0.041, 0.011]	0.3	-0.017	[-0.034, 0.001]	0.07
Marital Status, Not Married	0.016	[0.002, 0.03]	0.02	0.019	[-0.009, 0.046]	0.2	0.017	[-0.001, 0.036]	0.07
Days Between Referral Visit and Wilmer Visit	9.07e-5	[2.70e-6, 1.79e-4]	0.04	1.04e-4	[-7.26e-5, 2.81e-4]	0.3	9.72e-5	[2.28e-5, 2.17e-4]	0.1
Insurance, Commercial and Other	-0.023	[-0.041, -0.006]	0.009	-0.071	[-0.107, -0.036]	8E-05	-0.047	[-0.071, -0.023]	<0.001
Proliferative Diabetic Retinopathy, Yes	0.267	[0.229, 0.305]	<0.001	0.442	[0.366, 0.517]	9E-30	0.354	[0.303, 0.406]	<0.001
Chronic Kidney Disease, Yes	0.026	[0.009, 0.042]	0.003	0.035	[0.002, 0.068]	0.04	0.030	[0.008, 0.053]	0.009
Type 1 Diabetes, Yes	-0.030	[-0.056, -0.004]	0.02	-0.045	[-0.097, 0.006]	0.09	-0.038	[-0.073, -0.003]	0.04
Insulin Exposure, Yes	0.020	[0.006, 0.033]	0.005	0.032	[0.004, 0.06]	0.02	0.026	[0.007, 0.045]	0.007
Age	0.001	[0.001, 0.002]	<0.001	0.003	[0.002, 0.004]	<0.001	0.002	[0.001, 0.003]	<0.001

Table 3: Significant predictors from multivariable linear regression analysis. The response variables were the BCVA measures.

RESULTS (continued)

- The AI group was significantly enriched in several ways
 - Black race
 - Greater Medicare coverage
 - Greater systemic disease burden: HTN and CKD.
- Both groups presented with good vision
 - Median BCVA of the better-seeing eye:
 - SOC: 0 (Snellen 20/20)
 - AI: 0.1 (Snellen 20/25)
 - Median BCVA of the worse-seeing eye:
 - SOC: 0.1
 - AI: 0.1
- Referral group (SOC vs. AI) was not associated with better or worse-seeing eye BCVA.

LIMITATIONS

- Only one autonomous AI DED testing system used at one health system was examined.
- The small sample size of conditions such as proliferative diabetic retinopathy precluded certain additional analyses.

CONCLUSIONS

- Patients who underwent autonomous AI DED testing had higher systemic disease burden and corresponding higher risk for DED.
- However, there was no difference in presenting BCVA between referral groups.

IMPLICATIONS

- This may indicate that autonomous AI increases health equity for patients who are more at risk for poor visual outcomes by facilitating evaluation before visual damage has occurred.