



# Efficacy of a Student-Run Ophthalmology Service in Managing Diabetic Retinopathy: A Five-Year Retrospective Review

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## Abstract

**Background:** Diabetic retinopathy is a leading cause of blindness worldwide and can be prevented with appropriate glycemic control. The Health Outreach Partnership of EVMS Students (HOPES) Student-Run Free Clinic at Eastern Virginia Medical School (Norfolk, Virginia) provides both primary care and ophthalmology care to patients from under-served backgrounds. The purpose of this retrospective chart review is to assess whether student-run free clinic services are effective in preventing the development and progression of diabetic retinopathy.

**Methods:** Inclusion criteria were a diagnosis of Type 2 Diabetes Mellitus (T2DM), two or more HOPES Ophthalmology Clinic appointments separated by at least 4 months between January 2015 and July 2019, and medical management of T2DM by the HOPES Primary Care Clinic. Primary outcomes were HbA1c, visual acuity, and dilated fundus examination findings. Significance was calculated using two-sample T-tests.

**Results:** There were 174 HOPES Ophthalmology visits and 66 diabetic eye exam appointments in this time period. The average HbA1c for patients at the initial appointment with the ophthalmology clinic was  $7.77\% \pm 1.65\%$  and the average HbA1c at the most recent appointment was  $7.4\% \pm 2.28\%$ . Among all patients, there was no statistically significant change in visual acuity in either eye from baseline to the most recent visit ( $p=0.81$  for right eye and  $p=0.98$  for left eye). There was no change in fundus examination findings in any patient from their initial visit to their most recent visit.

**Conclusions:** The HOPES Clinic has been effective in preventing the development and progression of diabetic retinopathy in its patients who regularly follow up with both the primary care and ophthalmology clinics. This study highlights that a student-run free clinic is capable of making an impact in the community by preventing the development of a potentially blinding disease, but that further strategies to enable consistent patient follow-up are needed.

## Introduction

Diabetic retinopathy is one of the leading causes of blindness in the world, affecting nearly a third of all adults with diabetes.<sup>1</sup> Diabetic retinopathy can be classified based on fundus examination features. Non-proliferative diabetic retinopathy (NPDR) is characterized by microaneurysms, hemorrhages, and hard exudates due to retinal vessel abnormalities driven by glycemic-

induced vascular wall injury. NPDR may progress to proliferative diabetic retinopathy (PDR), in which neovascularization of the retina occurs. PDR can cause significant and permanent decreases in visual acuity due to the disruption of normal retinal architecture and presents an increased risk of potentially blinding complications such as tractional retinal detachment and neovascular glaucoma.<sup>2</sup>

Uncontrolled diabetic retinopathy can be dev-

astating and difficult to treat, particularly in patients who have limited access to medical care, so primary and secondary prevention of this ophthalmic disease is imperative. One study from the American Diabetes Association reported significant ethnic and racial disparities in rates of eye examination in adults between 2002-2009, which has continued to persist in more recent years.<sup>3-4</sup> Another study controlled for socioeconomic status and found that people of color had less diabetes care, possibly due to lack of insurance coverage.<sup>4</sup>

In addition to having a severe impact on the individual, diabetes-related blindness is estimated to cost the United States \$500 million per year, so preventing the development of diabetic retinopathy is also financially prudent.<sup>5</sup> Good glycemic control has been shown to prevent the development and progression of diabetic retinopathy.<sup>6</sup> Hemoglobin A1c (HbA1c) is often used as a metric and goal marker for good glycemic control, as measuring the HbA1c level gives the clinician a marker of the patient's blood sugar control over the past three months. HbA1c levels of 6.5% and above correlate to an elevated risk of diabetic retinopathy.<sup>7</sup>

Eastern Virginia Medical School's (EVMS) Health Outreach Partnership of EVMS Students (HOPES) in Norfolk, Virginia is a student-run free clinic that serves patients who are underinsured and have an income of less than twice the federal poverty level in the Hampton Roads area. Attending physicians include local physicians who volunteer to see HOPES patients. All other clinic staff members including student clinicians, laboratory services, and clinic coordinators are volunteer medical and health professions students from EVMS. In addition to providing primary care services, HOPES also offers subspecialty services such as ophthalmology, dermatology, mental health, and orthopedics.

The HOPES Ophthalmology Clinic runs once a month and works closely with the HOPES primary care clinic to provide comprehensive eye examinations to patients in need. For example, patients newly diagnosed with diabetes in the primary care clinic are automatically referred to the ophthalmology service for a comprehensive eye exam with dilation. These patients are expected to maintain routine care with primary care services who manage their medications, encourage a healthy diet and exercise routine, and

obtain regular blood glucose levels and HbA1c. Prevention of diabetic retinopathy is done through these routine checks and appropriate follow up. Diabetic retinopathy is treated first and foremost by appropriate screening, and aggressive glycemic control. By providing a clinic that is affordable and, most significantly in this population, available, we prevent progression through primary interventions and secondary interventions. Thus far, we fortunately have not required laser treatments, anti-vascular endothelial growth factor injections, or more invasive means of managing diabetic retinopathy. However, the resident clinic is available for referral for patients who have disease progression.

Although this close relationship between the primary care service and the ophthalmology service would ideally ensure that patients maintain adequate glycemic control and prevent development or progression of diabetic retinopathy, the HOPES Clinic, much like many other free clinics, encounters barriers relating to continuity of care and treatment adherence, largely due to socioeconomic factors.<sup>8</sup> Patients often miss appointments due to long work hours, lack of transportation, or difficulty maintaining communication with the clinic due to language barriers or lack of reliable telephone access. In addition, demand for subspecialty appointments with the HOPES Clinic is high, resulting in a relatively long wait list for appointments and necessitating scheduling of non-urgent appointments often months away.

This study examines the development or progression of diabetic retinopathy in patients who are medically managed by the HOPES primary care clinic for their diabetes and are followed by the HOPES ophthalmology clinic for regular diabetic eye exams. Primary endpoints of this study include visual acuity, fundus examination findings, and most recent HbA1c. The study will assess if the free clinic services have been successful in preventing the development of diabetic retinopathy in patients with significant barriers to medical care.

## **Methods**

### *Selection and Description of Participants*

This is a retrospective chart review of all visits in the HOPES Ophthalmology Clinic from

January 2015 to July 2019. HbA1c, visual acuity, and fundus examination findings from these visits were compiled into a de-identified database. Inclusion criteria were the following: a clinical diagnosis of Type 2 Diabetes Mellitus (T2DM), two or more HOPES Ophthalmology Clinic visits at least 4 months apart, and diabetic management by the HOPES primary care clinic. This study was approved by the EVMS Institutional Review Board. All research adhered to the principles of the Declaration of Helsinki.

### Statistics

Average visual acuity was calculated using LogMAR conversions.<sup>9</sup> All statistical analysis including two-sample T-tests were performed in RStudio (version 3.6.1, RStudio, Boston, MA). Statistical significance was defined as  $p \leq 0.05$ . All figures and tables were made using Microsoft Excel (version 16.16.27, Microsoft Corporation, Redmond, WA) and Prism 7 (version 7.0a, GraphPad Software, San Diego, CA).

### Results

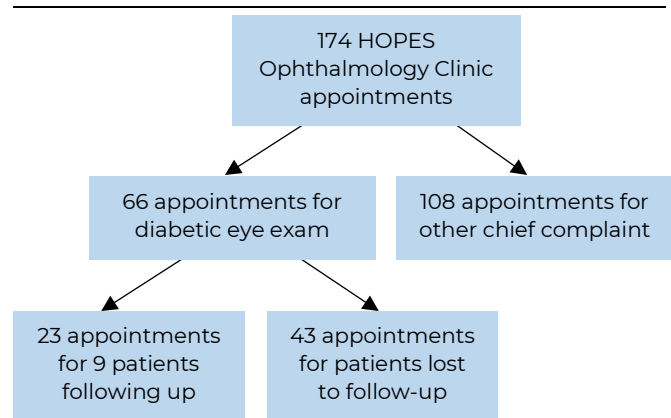
There were 174 HOPES Ophthalmology Clinic appointments between January 2015 and July 2019. Of these appointments, 66 included diabetic eye exams. Based on the inclusion criteria, nine patients qualified for inclusion in statistical analysis (Figure 1). These nine patients had a total of 23 appointments with HOPES Ophthalmology Clinic for a mean of 2.6 visits per patient. The mean time between each ophthalmology appointment was 14 months.

Of these nine patients, seven patients were male and two were female. Their ages ranged from 39 to 62 years old with a mean age of 53 years old and median age of 55 years old. All nine patients were diagnosed with type 2 diabetes mellitus by a primary care physician either at the HOPES primary care clinic or at an outside doctor's appointment.

The average HbA1c for patients at the initial appointment was  $7.77\% \pm 1.65\%$  and the average HbA1c at the most recent appointment was  $7.4\% \pm 2.28\%$  ( $p=0.69$ ,  $n=9$ ) (Figure 2).

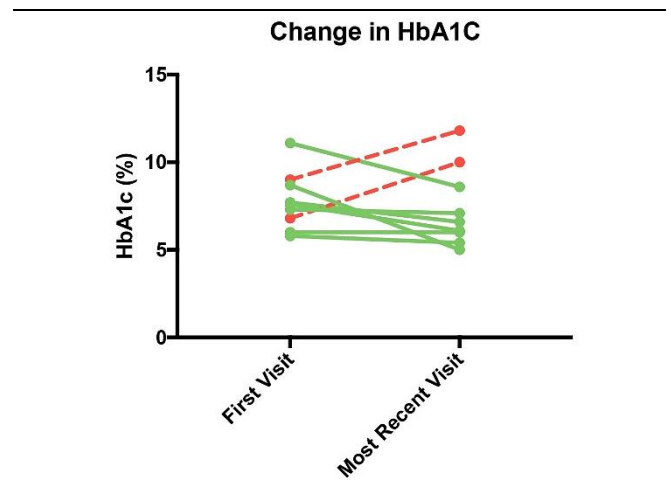
Patients' average visual acuity in the right eye at the initial appointment was 20/27 and the average visual acuity in the right eye at the most re-

**Figure 1.** Flow chart of patients seen by HOPES Ophthalmology Clinic from January 2015 to July 2019

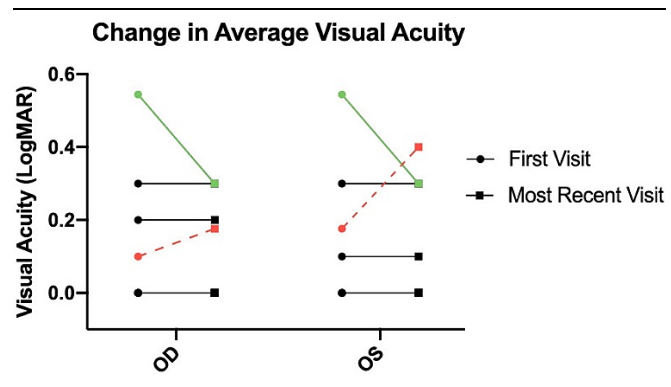


HOPES: Health Outreach Partnership of EVMS Students

**Figure 2.** Hemoglobin A1c (HbA1c) of all patients at their initial visit and most recent visit



**Figure 3.** Average visual acuity measured in LogMAR in each eye from patients' initial visit to their most recent visit



LogMAR: Logarithm of the Minimum Angle of Resolution; OD: right eye; OS: left eye.

**Table 1.** Summary of patients' initial visit and most recent visit

Characteristics	Patient									
Identifying Number	1	2	3	4	5	6	7	8	9	
Sex	M	M	F	F	M	M	M	M	M	M
Age	53	54	62	59	56	58	55	42	39	
Number of Appointments	2	4	3	2	3	3	2	2	2	
Diabetes Management	Medication	Medication	Diet-Controlled	Medication	Medication	Medication	Diet-Controlled	Medication	Medication	
Previous HbA1c (1st Visit)	7.7	6.8	5.8	7.6	11.1	9.0	6.0	7.3	8.7	
1st Visit Subjective	Blurry near vision	Needs reading glasses, decreased VA when glucose is high	Chronic blurred vision OS>OD	Follow up after diagnosis of diabetes	Floaters	Worsening blurry vision	Sporadic pain and burning OU	Diabetic eye exam	Blurry vision	
1st Visit VA OD	20/25	20/20	20/20	20/20	20/40	20/70	20/20	20/20	20/32	
1st Visit VA OS	20/25	20/30	20/20	20/20	20/40	20/70	20/20	20/20	20/20	
1st Visit Fundus Exam OD	No retinopathy	No retinopathy	No retinopathy	No retinopathy	Mild-moderate NPDR without edema	Mild diabetic changes	No retinopathy	No retinopathy	No retinopathy	
1st Visit Fundus Exam OS	No retinopathy	No retinopathy	No retinopathy	No retinopathy	Mild-moderate NPDR without edema	Mild diabetic changes	No retinopathy	No retinopathy	No retinopathy	
Previous HbA1c (Most Recent Visit)	6.6	10.0	5.4	6.1	8.6	11.8	6.0	7.1	5.0	
Most Recent Visit Subjective	Progressively worsening vision	Needs new glasses	Constant blurriness in distance	Follow up after diagnosis of glaucoma	Bilateral floaters, decreased VA, glare	Blurry central vision	Bell's Palsy OD and decreased VA OD	Diabetic eye exam	Diabetic eye exam	
Most Recent Visit VA OD	20/30	20/20	20/20	20/20	20/40	20/40	20/20	20/20	20/32	
Most Recent Visit VA OS	20/25	20/50	20/20	20/20	20/40	20/40	20/20	20/20	20/20	
Most Recent Visit Fundus OD	No retinopathy	No retinopathy	No retinopathy	No retinopathy	Mild NPDR	No retinopathy	No retinopathy	No retinopathy	No retinopathy	
Most Recent Visit Fundus OS	No retinopathy	No retinopathy	No retinopathy	No retinopathy	Moderate NPDR	No retinopathy	No retinopathy	No retinopathy	No retinopathy	

HbA1c: Hemoglobin A1c; VA: visual acuity; OD: right eye; OS: left eye; NPDR: non-proliferative diabetic retinopathy.

cent appointment was 20/26 ( $p=0.81$ ,  $n=9$ ) (Figure 3). The average visual acuity in the left eye at the initial appointment was 20/27 and the average visual acuity in the left eye at the most recent appointment was 20/27 ( $p=0.979$ ,  $n=9$ ).

There was no change in fundus examination findings in any of the patients from their initial visit to their most recent visit (Table 1). Seven patients had no findings associated with diabetic retinopathy at their initial visits or on subsequent follow-up, while two patients presented with bilateral fundus examination findings related to diabetic retinopathy such as cotton wool spots and hemorrhages that were stable from baseline to their most recent visit.

## Discussion

The purpose of this study was to assess if the HOPES primary care and ophthalmology services were effective in preventing the development and progression of diabetic retinopathy. Although average visual acuity improved from the initial visit to the HOPES Ophthalmology Clinic to the most recent visit, the change was not statistically significant in both eyes ( $p>0.05$ ). HbA1c improved from an average of 7.7% to 7.4%, but this finding was also not statistically significant. Seven patients had an improvement or no change in their HbA1c levels from the initial to most recent visit. The two patients whose HbA1c increased from the initial to most recent visit were not adherent to medical management of their diabetes and home glucose checks. There was also no significant change in retina findings seen in any dilated fundoscopic examination, including two patients who initially presented with pathologic changes. In addition, patients did not report orally to the student clinicians who took their history any significant subjective change in their vision over the course of their visits. These findings demonstrate that diabetic patients who had appropriate continuity with the EVMS HOPES Clinic and maintained good glycemic control were less likely to exhibit signs and symptoms of a developing or worsening retinopathy.

Although it is reassuring that patients attending the HOPES primary care and ophthalmology services did not have any development and progression of diabetic retinopathy, this study has

clear limitations. This study's sample size of nine patients is small, leading to a low statistical power, limited by the number of patients who completed follow up at HOPES for both primary care and ophthalmology. This was likely due to multiple factors related to limited access to medical care, a problem in the Hampton Roads community that the HOPES Clinic is designed to ameliorate. For example, it is not uncommon for patients at HOPES to report that they have been unable to afford their medications or that they had recently become homeless. This also unveils a potential confounding factor, which is that patients who are more likely to follow up are also patients who have better social support and are more likely to be able to manage their disease successfully.

While this study has shown that the patients with continued follow-up at HOPES did not have development or progression of diabetic retinopathy, it has also highlighted patient access to consistent care as an area for needed improvement. Many patients were lost to follow-up for multiple reasons primarily related to the social determinants of health. HOPES has made improvements designed to address this issue, including creating a role for a dedicated ophthalmology continuity coordinator to maintain a list of patients who need to follow up and implementing reminder texts before each appointment. Some solutions the HOPES Ophthalmology Clinic may explore in the future include increasing the number of ophthalmology clinics per month and coordinating primary care and ophthalmology service visits on the same day to reduce the time and transportation burden for patients.

Our study has shown that free clinic primary care and ophthalmology services can be effective in preventing the development and progression of diabetic retinopathy in patients who regularly follow up with both primary care and ophthalmology services. This is evidenced by the maintenance of visual acuity and HbA1c in our patients as well as the absence of changes in fundus examination findings over time. However, no major conclusion can be drawn from this study due to the small sample size, and this needs to be addressed in the future to collect a sufficient number of patient records to garner sufficient power. This study also shows that while changes have

been implemented to improve patient access to care, further refinements are needed to expand and optimize the care the HOPES Ophthalmology Clinic can provide to the community. By providing services that enable patients to maintain consistent primary care and ophthalmology follow-up, patients with diabetes can maintain glycemic control to prevent progression to diabetic retinopathy.

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### **Disclosures**

The authors have no conflicts of interest to disclose.

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